ISSN 0972-1185

ARTHA BEEKSHAN

JOURNAL OF BANGIYA ARTHANITI PARISHAD
(Bengal Economic Association)
ASSOCIATE MEMBER OF THE INTERNATIONAL ECONOMIC ASSOCIATION

Vol. 27, No. 4 March 2019

SPECIAL ISSUE : 39TH ANNUAL CONFERENCE PAPERS

Sponsored by :

ICSSR

NABARD

ARTHA BEEKSHAN

(Journal of the Bengal Economic Association)
Reg. No. 53099/92

Artha Beekshan is a quarterly referred journal in economics and allied subjects published by the Secretary, Bangiya Arthaniti Parishad. Contributed articles relating to research in economics and allied subjects are considered for publication by the Editorial Board. The reviews of books and monographs are also often published in this journal. From 2013 onwards, the journal has been selected by ICSSR as belonging to the set of top 210 social science journals in India, and indexed regularly by ISID. Authors should follow the guidelines, appended in the volume, before submission of their papers. The publisher shall not assume any responsibility to share the views of the authors contained in their articles.

Online submission of papers for the journal may be made to : **arthabeekshan.bea@gmail.com** . Each submitted paper is peer-reviewed double-blind by a panel of distinguished Referees. For subscription, Contribution of Articles, Book Reviews, Advertisements, Collection of Copies and for any other communication contact, Office of Bangiya Arthaniti Parishad, 87/277,Raja S.C.Mallick Road, Kolkata-700047.

ARTHA BEEKSHAN

(JOURNAL OF BANGIYA ARTHANITI PARISHAD)
(Bengal Economic Association)
Vol. 27, No. 4, March 2019

BANGIYA ARTHANITI PARISHAD
(Bengal Economic Association)
[Associate Member — International Economic Association]

Office :
Bangiya Arthaniti Parishad, 87/277, Raja S. C. Mallick Road,
Ganguly Bagan, Kolkata - 700 047.

Artha Beekshan, Volume 27, No. 4, March 2019

Publication of ***Artha Beekshan***, the quarterly referred journal of Bangiya Arthaniti Parishad, that is, the Bengal Economic Association, is one of the most important academic activities of the Association. The present volume, **Volume 27, No. 4** of the Journal, is published containing the selected papers contributed by scholars for the 39th Annual Conference. We are thankful to the authors and members who have helped in one way or other in the preparation of this volume.

The publication of this issue of Artha Beekshan is helped by grant from **ICSSR and NABARD .**

I would like to extend my whole-hearted thanks to the Editorial team, the Publisher, and all who have helped in the publication process, and especially the office bearers of Bangiya Athaniti Parishad for their kind endeavours to make this issue of **Artha Beekshan** viable and **Kolkata Mudran** for bringing out the present issue.

Editor in Chief

Certificate of Registration

1.	**Name of the Journal**	:	**ARTHA BEEKSHAN (Journal of Bengal Economic Association)**
2.	**Registration Number**	:	**53099/92**
3.	**Language**	:	**English**
4.	**Periodicity**	:	**Quarterly**
5.	**Retail Selling Price**	:	**Complementary for Members**
6.	**Publisher**	:	**Secretary, Bangiya Arthaniti Parishad**
a.	**Nationality**	:	**Indian**
b.	**Address**	:	**87/277, Raja S. C. Mallick Road, Ganguly Bagan, Kolkata - 700 047.**
7.	**Editor in Chief**	:	**President, Bangiya Arthaniti Parishad**
	a. Nationality	:	**Indian**
	b. Address	:	**87/277, Raja S. C. Mallick Road, Ganguly Bagan, Kolkata - 700 047.**
8.	**Printing where printing is conducted**	:	**Kolkata Mudran , 12, Biplabi Pulin Das Street, Kolkata -700009, Phone: 033-2354-6891.**
9.	**Place of Publication**	:	**Ganguly Bagan, Kolkata – 700 032.**

The financial assistance received from Research and Development Fund of National Bank for Agriculture and Rural Development (NABARD) towards publication of the Conference issue of the journal as the proceedings of the Conference is gratefully acknowledged.

We gratefully acknowledge the support from ICSSR towards publication of this Conference issue of the Journal, Artha Beekshan.

Artha Beekshan, Volume 27, No.4, March 2019

OIL CRISIS AND GLOBALIZATION: WHERE ARE WE HEADED?*

Dipankar Dasgupta#

There are at least three different issues surrounding the oil economy. Economists might wish to associate them with the short, the medium and the long run. The short run involves economics as well as politics. The economics of oil in the short run is concerned with trade deficits of oil importing countries. Such deficits affect the economies' health in diverse ways, including currency depreciation, inflation and weak GDP growth. The politics of short run oil concerns the middle east mostly, but also countries such as Venezuela, Nigeria and others. The political problems are somewhat beyond the scope of pure economic analysis, though not of political economy. The medium run in turn is also associated with the negative effects of the short run, but adds to them serious issues linked to environmental damage, global warming and sustainability of globalization. In the extreme case, the Ricardian theory of comparative advantage and trade itself could run into trouble. Finally, in the long run, the world will have no oil left in its bowels, the price of oil will surge to monumental levels and the survival of human society will crucially involve technologies dependent on alternative and hopefully renewable energy sources.

Let us ignore the short run problem, partly because it doesn't involve questions that are too hard to fathom. The medium and the long run though raise harder questions. We may address these questions here, even if we do not have clear answers to them. The latest developments in the oil industry are yet to be fully analyzed. I shall therefore restrict myself to what was more or less clearly known till 2010 or so, when the world was caught in the clutches of the sub-prime crisis. Even at that time, it was obvious that the world's oil wells were running out. They will of course run dry eventually. What's little appreciated, a well loses fertility before it is actually empty. Moreover, Independent of the technology of oil extraction, what's left is not worth running after. How fast can new supply sources be discovered to replace a depleting oil well? In his book "Why Your World Is About to Get A Whole Lot Smaller", subtitled "Oil and the end of Globalization",[1] Jeff Rubin estimated in 2009 that at the then rate of depletion, 20 million barrels per day of new production was needed over the next five years simply to keep global production at its existing level. Even with easily available oil, such as in the middle east, this would not have been easy. In fact though, Rubin was not talking about easy availability, so matters were worse. The easily available oil fields had been

*Presidential Address, 39th Annual National Conference of Bangiya Arthaniti Parishad, march 9, 2019

Formerly Professor of Economics, Indian Statistical Institute, Delhi and Kolkata.

sucked up already. From the North Sea to Mexico, from Russia to Indonesia, oil wells were producing less oil than in the past. Oil wells were depleting at the time at the rate of 6.7 per cent each year.

The situation was particularly bad in the US, the world's largest oil market. Production had literally halved from 10 mbp day in 1970 to 5 mbp day around 2010. The situation could have been under control if people were consuming less oil, but in fact it was just the opposite. Oil consumption had gone up from 15 mbp day in 1970 to 20 mbp day. The scenario was no different in the rest of the developed world, supply was falling in the face of rising demand. The US believed it had found a solution in the Gulf of Mexico. The oil and gas reserves in the Gulf were hard to reach of course. British Petroleum had to drill 120 miles off the coast, in water that was one mile deep and more than 3 miles below the ocean bed. The Gulf was expected to yield around half a mbp day eventually. However, a series of hurricanes, Katerina, Rita, Dennis, Ike and Gustav ensured that the gigantic off shore infrastructure was actually quite fragile. The frequency of these hurricanes is rising with global warming.

The difference between the price of gasoline that comes out of refineries and the crude oil that goes in is called "cracking spread". Prior to the hurricanes, the spread was around $10 per barrel of oil. With refineries (located mostly in the Houston area) ravaged by the hurricanes, the demand for refinery capacity rose beyond control and the price of gasoline at the gas stations shot up. A standard barrel of oil consists of 42 gallons. With a rise in cracking spread from $ 10 per barrel to $ 50 per barrel, the price of a gallon of refined gasoline rose by 75 cents excluding the price of crude oil itself. In US, motorists found themselves paying the equivalent of around $ 100 per barrel of oil, even though the actual price of oil was $ 30 less.

Another problem with the Gulf of Mexico oil is that, like other deep-sea projects, the wells deplete faster than onshore oil fields. The technology used for offshore oil can be likened to a longer straw to suck out the reserves. Some experts believe that a peak in offshore oil supply is not far away. Dependence on deep-water oil leads to accelerating depletion as well.

Of course, economics equipped itself with the notion of a rising supply curve. In Marshallian language, larger output calls for a higher supply price. So, more expensive technology was lying around to be discovered along with harder to access oil reserves. How high was the depletion rate just prior to the sub-prime crisis? It was around 4 mbp day. To replace it in the face of depleting oil supply meant running faster each day simply to keep the oil supply at a static level. In fact though, the world wished to use more oil and this led to new high-cost sources of supply like the Canadian oil sands in northern Alberta where temperatures drop to -20 °F. Roughly two tons of sand contain a barrel of oil. Multi-million dollar trucks are required to carry the sand out and digging it out requires monstrous steam shovels, each of which burn 4,250 gallons of diesel a day to dig up the sand. If the market price for oil is high enough, Canadian sands will be a viable source of oil. On the other hand, if the market price of oil falls to (say) $40 a barrel, Canadian oil will not be extracted. Around the sub-prime crisis period, when world oil demand had fallen drastically, super-expensive oil from Canadian sand was not a feasible idea. However, if the price of oil rose to $100 or more, which it did for a while, high cost oil sources will become viable.

Note that financial cost and revenues are not the only matters that should concern us in this context. We have already noted that oil (or, diesel) itself is a resource that is necessary to produce crude oil. This means that energy cannot be created without using energy. Hence, one needs to consider the net energy supply, quite apart from profits and losses. If the net energy produced is insufficient, the technology cannot be viable, even if it yields profits in the usual sense.

What do we know about the demand side of the oil market? Is oil, which is a non-renewable resource, used frugally? Unfortunately, the answer to this question might sound somewhat dismal. In Dubai, it might be hot enough to melt you, but every day there is an amazing quantum of snow available for skiing. Ski Dubai's Snow Park provides 3,000 square meters of year-round perfect snow in the middle of a hot desert. Ski Dubai and the massive mall that houses it use the energy equivalent of 3,500 barrels of oil per day. Nearly that number of people visit the site each day, so the that oil consumption amounts to a barrel per day for each visitor. The figure needs to be compared with what the quantum of oil an average American burns in his car per month. Dubai has every right to use up its own oil, but the way it uses it up, leaves a frighteningly small reserve for the rest of the world, including emerging market economies such as China and India. With our growth ambitions, our demand for oil too is growing, but this is happening in the face of luxurious waste elsewhere.

Between 2000 and 2008, world oil prices increased over sevenfold, from $20 per barrel to $150 per barrel. The OPEC oil shocks of the 1970's were negligible by comparison. Yet global demand had shrunk at the time and oil prices had actually fallen as a result. Following the sub-prime crisis too, oil prices crashed. However, what is not immediately evident is why oil demand defied the phenomenal price rise before the crisis struck.

During most of that decade, oil demand had been rising along with prices. Analysts point out that the reason underlying the phenomenon was the multiplicity of markets. In the developed OECD countries, demand did shrink. But the rapidly industrializing countries ensured that automobile production was booming in any case and more people were driving cars. Driving cars amounted to demanding oil, so that it was not clear what the net effect of rising oil prices was on oil demand. As some believe, the majority of the world's automobiles will be driven not in the developed west, but in growing India and China, which boast not only large populations but also millions of first time drivers. Quite apart from China, car sales went up

30 per cent in Russia and Brazil in 2007. Low priced cars, such as the Nano, reduce the savings necessary to buy a car and make them available for purchasing gasoline.

That, however, was not the only source of demand. In 2007, OPEC and two nonmember oil-producing countries, Russia and Mexico, consumed 13 mbp day of oil. This is almost twice as large as China's 7.5 mbp day and one mbp day more than the daily oil consumption of Western Europe. Why do oil producers themselves consume more oil than non-oil producers? The answer doesn't lie in the cost of buying a car, but in the low price charged for oil. Triple digit oil prices may have meant $4 a gallon for gasoline in the US, but in Venezuela and Tehran, the price was only around 25 cents per gallon. Saudi Arabian motorists paid only marginally more. Oil here is massively subsidized and that is a political decision, unlinked to world demand and supply considerations. Governments that tried to raise prices in oil-producing countries quickly faced uproar from the public. The more the rise in world oil prices, the more the oil-producers are able to earn and hence subsidize and this in turn fuels demand for oil in these countries. The existence of these subsidies (largely in OPEC countries, but elsewhere too) guarantees that elsewhere in the world, higher prices will need to be paid.

Quite apart from this, 30 per cent of electricity generation in OPEC countries comes from oil-fired, as opposed to natural gas fired generating plants, whether it is a steam, diesel turbine or internal-combustion-driven generating station. Saudi Arabia gets half of its power from burning oil. Power production in the Middle East already uses up about one-third of a million bpd of oil. They cannot burn coal of course, nor can they go for nuclear power plants for well-known political reasons. Quite apart from this, the petro-dollars ensure that power demand in these countries is increasing rapidly. In Dubai, for example, the rate of growth is 15 per cent per year. Per capita power demand in the Middle East is the highest in the world and exceeds even American standards.

In countries like Saudi Arabia, use of fresh water in underground aquifers is seven times its sustainable level. Most of this is used for agriculture and countries in the Middle East face a difficult choice between water and food. Saudi Arabia is investing in other countries' agriculture to meet its own food requirements. However, there is ample supply of salt water in the region and therefore desalination becomes a possible way out of water shortage. Desalination is an energy-intensive technology. Saudi Arabia has the world's largest desalination facility and it was supposed to reach its full capacity of 31 million cubic feet of water per day in 2009. But more such plants were in the making and the target was to raise the country's desalination capacity by 80 per cent. To replenish the water it depletes in aquifers, it will have to burn 300,000 barrels of oil or natural gas per year. According to the World Bank, desalination in the Middle East will require around a million bpd of oil. To that extent, the world's oil supply will be affected.

Quite apart from all this, the Middle East is turning into a major centre of the global petrochemical business and this requires enormous quantities of fossil fuel. The business is more lucrative compared to cracking. Through acquisition of Western companies and technology, Saudi Arabia is turning into a major petrochemical centre.

There is yet another interesting reason why oil demand is surpassing supply. Soon after the OPEC oil shocks were in place in the 1970's, the major oil using developed countries responded by designing more fuel efficient transport technology. The same amount of fuel began to produce more mileage. The immediate impact was a leftward shift in the demand curve for oil and a fall in oil price. However, that very same fall in turn began to produce a greater demand for oil. The more efficient technology was used soon, not to produce smaller cars, but larger fuel efficient cars. And these larger cars began to consume just as much energy as in the past. Somewhat similar events occurred in the aviation technology. Lower prices led people to fly more and end up using more fuel. And, paradoxically, efficient technology led to greater wastage of oil.

Alternative avenues opened up too, the use of ethanol, or bio-fuel, being one of them. Unfortunately, this did not solve the problem either. Among other things, ethanol is usually extracted from corn. Corn production uses fertilizers that are cropped with the help of enormous quantities of natural gas. To move them around, one needs gasoline driven trucks. Finally, with better returns from corn production for ethanol, producers shifted from producing other crops to producing corn, thereby reducing the supply of traditional agricultural products and raising their prices. It is unlikely that bio-fuels will solve the oil problems.

The recent shale gas revolution, or fracking, could well substitute for depleting oil reserves in the long run. However, by the time traditional fossil fuels are substituted by shale gas, the price of oil could well go through the roof. Besides, the way shale gas exploration is progressing, major supply sources could shift towards the US and one doesn't know what US pricing policy will turn out to be with the passage of time.

The other serious problem[2] associated with fossil fuels, including shale oil, is global warming. In 2015, at the U.N. Climate Change Conference in Paris, the world's governments, noting that the earth has so far warmed a little more than one degree Celsius above pre-industrial level, set a goal of holding the increase this century to 1.5 degrees Celsius. Last October, the UN published a special report stating that global warming could reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. In the face of environmental deterioration, the looming question is whether the human game has begun to falter. In June, 2018, the Food and Agriculture Organization of the U.N. found that child labour, after years of falling, was growing, driven in part by an increase in conflicts and climate-induced disasters.

A team of scientists pointed out recently, the physical shifts caused by climate change will extend longer than the entire history of the human race.

During the past two hundred years, immense quantities of coal, gas and oil were burnt. The effect was that carbon atoms combined with oxygen atoms in the air to produce CO_2. This, along with other gases like methane, has trapped heat that would otherwise have escaped into space. Even in the Permian Age, when huge injections of CO_2 from volcanoes burning through coal deposits led to the "The Great Dying", the CO_2 content in the atmosphere was two hundred and seventy-five parts per million. Now it has topped four hundred parts per million and is rising more than two parts per million each year. The extra heat we trap near the planet everyday is equivalent to the heat from four hundred thousand bombs the size of the one dropped on Hiroshima.

The last 30 years have witnessed all twenty of the hottest years ever recorded. The melting ice caps and glaciers, initially predicted for the end of the century, have already occurred. In this connection, teams of scientists reported that there was a 35 per cent chance that unexpectedly high economic growth rates will make the U.N.'s worst-case scenario for global warming look over-optimistic.

Chances are high that the world will grow smaller and this for two reasons. First, on account of the enormous rise in transport costs, globalization will turn into a chimera. Secondly, at the current pace of global warming, sea levels will rise more than ever and leave only a fraction of the present day human habitations livable. And it is not too clear that the dismal science of economics has much to offer to avoid the possibility of a cataclysm. One wishes nonetheless that either a miracle, or human wisdom, hopefully the latter more than the former, will make the world of tomorrow prettier than today's.

Reference :

[1] Random House, 2009. The book is the fountainhead of information on which this write up is based.

[2] Cf Bill McKibben: How Extreme Weather Is Shrinking The Planet, The New Yorker, October, 2018

Artha Beekshan, Volume 27, No.4, March 2019

RISK MANAGEMENT: AN EVOLVING DISCIPLINE[1]

BASABI BHATTACHARYA[+]

Abstract

Post globalization era has experienced increased interlinkage among the financial markets, varied financial innovations, and a huge influx of financial market players. As a result of growing financial complexities, financial systems have become highly risk sensitive and therefore vulnerable to risk mishaps necessitating evolution risk management as a discipline. This paper gives an overview of the process of risk management coming in the forefront of business practices. It discusses some risk disaster scenarios of the past, classifies major types of risks, summarizes the Basel issues, provides an insight into the features of financial risks, and briefly explains various risk measurement methods. Among the three major types of risks, market risk, credit risk and operational risk, the study focuses on operational risk, given its all–encompassing nature. It is proposed that a holistic approach following a system analytical framework is to be undertaken in order to deal with the risk complexities in the contemporary macro financial domain.

Key Words: Risk management, Basel, systems approach, operational risk

JEL Classification Codes :G14, G 21, G32.

I.Introduction

Over the last few decades, financial markets have evolved significantly in the wake of financial liberalization. Markets have become more interactive, more sensitive, and more complex. Emergence of newer financial products, and enhanced activity in financial markets along with increased interlinkage among the functioning channels have made the economic systems more vulnerable to systemic disturbances than it was before 1990s. In the backdrop of enlarged global complexities followed by enhanced financial risk sensitivities, managing risk has emerged as a priority agenda to the organizations. Falling short of this major concern may raise the question of basic survival of the entities. Financial disasters of the past could not be well apprehended a priori due to lack of risk awareness. The resultant effects were collapse of the financial and economic systems at large. A well-structured risk awareness and management practice was a requirement. This involved recognizing or identifying the risk, assessing the type and magnitude of the risk and dealing with it with adequate capital buffer to safeguard against probable financial loss, which is much beyond the scale and intensity of

---

1. 3[RD] Giribala Karmakar Memorial Lecture at the 39[th] Annual Conference of the Bangiya Arthaniti Parishad on 9[th] March 2019.

+ Former Professor of Financial Economics, Department of Economics, Jadavpur University, Kolkata;Email:basabi54@gmail.com

the usual profit and loss profile of a running entity. Risk management thus gradually evolved as a discipline. Although nothing was ever risk free, risk complexities have assumed magnum proportions influencing the global and regional systems adversely. Correspondingly, risk management principles and methods of regulation and supervision have surfaced and are continually being revised and upgraded as an evolving discipline.

The concept of risk management goes back to the 1960s and the 1970s when it was used to address property and casualty contingencies. More recently, risk management has become a comprehensive management process for identification, analysis, measurement, and control of various kinds of risks also including the regulatory aspect, organizational and structural matters. In the contemporary global context, the complex risk web encompasses all individuals, and organizational entities. Being compelled to live in a risky world, each entity has to be aware of its own risk profile, identify the underlying risk factors, understand their dynamics, quantify their influence on the portfolio value. Once the dimension and severity of probable risk is measured, the final step in this process is making informed decisions about the likely risk exposure.

Risk itself is not bad. There is always a trade – off in the risk return space. Higher risk will require higher return. So in the risk return space, anyone can choose to be anywhere in that space. For a rational investor the tendency would be to maximize return given risk and minimize risk given return. The underlying assumption here is that risk is properly priced and well apprehended and risk ethics is followed. However, risk, which is mispriced, mismanaged, un-apprehended or misunderstood is bad. A risk mishap in an entity at a micro level can magnify at a macro level through systemic interactions. Each entity, financial, non-financial, or corporate, needs to manage risk with a high level of risk foresight. Risk regulations should not be looked upon as impositions by the regulators. These are rather ways to understand, monitor, and control probable future mishaps.

This paper gives an overview of the gradual development of the understanding of risk as an evolving discipline over the years. It discusses risk scenarios, major types of risks, Basel issues, risk features and risk measurement issues in the subsequent sections. The study highlights that among the three major types of risk, market risk, credit risk and operational risk, operational risk, given its nature, deserves significant importance in the evolution of risk culture. A holistic approach, following a system theoretic framework, is proposed here to understand the functioning of economic and financial systems and generation of risk within the systems.

II. Some Risk Scenarios and Risk Generated Disasters

Risk management was prevalent since the 1960s, but emerged more fully in the 1990s in response to financial institutions' quest for sound risk management systems during the time of huge financial disasters. Some of the disastrous incidents are mentioned as below.

The Russian government default of August 1998- Long-Term Capital Management was a hedge fund that conducted leveraged trades involving both securities and derivatives on a large scale and used highly sophisticated mathematical approaches to manage its risk. The firm suffered a severe loss of capital when prices moved against its positions following the Russian default.

Barings Bank -The bank collapsed in February 1995 with a huge loss of $1.3 billion due to unauthorized derivatives trading in the Japanese Nikkei stock market by a single trader, Nick Leeson. All of these losses were accumulated without the bank's management being aware of them.

Daiwa Bank -Japan Daiwa bank announced losses of $1.1 billion on September 1995, which were attributed to Toshihide Igushi, a trader who accumulated huge losses over 11 years whilst trading in the U.S. Treasury bonds market.

Orange County-California's Orange County went bankrupt in November 1994 when Bob Citron, the County Treasurer, invested a huge amount in highly risky derivatives. Interest rate hikes in 1994 led to huge losses of $1.7 billion. The board members were not aware of the risks that Citron undertook.

Metallgesellschaft- MG Refining and Marketing, the US subsidiary of Germany's Metallgesellschaft AG declared losses of $1.3 billion in the futures market; when oil prices fell sharply in 1993. Consequently the U.S. subsidiary of MG suffered basis risk[1] due to huge positions in oil futures built to 'hedge rolling' their long term exposure.

These disasters disclosed a severe lack of control and absence of risk management present in these institutions, which allowed some individuals to have control over back office activities and trading desks. In general, these disasters are the inevitable consequences of weak risk management systems.

III. Types of Risks

There exists a galaxy of risks covering both financial and non financial risks. Among these, three broad risk types have been identified which are market risk, credit risk, operational risk.

Market risk: It is defined as the risk that the value of an investment may decrease due to moves in market factors. Such moves are based on market sentiments, varied reactions of different market players such as speculators, hoarders, hedgers, arbitrageurs and many other factors, financial or non financial.

Credit risk: Basel defined it as the possibility of a loss as a result of a situation that those who borrow money from the bank may not fulfill their obligations. This may take place due to borrowers' ill motivation or business failure or inefficient default assessment or faulty bank lending policy to less creditworthy borrowers.

*Operational Risk***:** Operational risk, broadly speaking, is the risk of loss from an operational failure. Conventionally operational Risk is defined in Basel as the risk of loss resulting from inadequate or failed processes, people, and systems or from external events. It thus has a wider coverage in the risk arena as it incorporates risks in organizational functionalities and risk ethics. It has also a deeper risk perception as is harps on origination of risk rather than risk outcome.

This definition highlights four sources of operational risk factors :

*People***-** employee fraud/malice (criminal), unauthorized activity/employee misdeed (willful**),** workforce disruption, loss or lack of key personnel

Processes- risks involved in the organizational process such as payment/settlement/delivery risk, documentation or contract risk, valuation/pricing, internal/external reporting and compliance, project risk/change management, selling risks etc.

Systems- system of business operation along faulty lines**,** system failures, systems security breach etc.

External **-**legal/regulatory risk/public liability, outsourcing/supplier risks, in-sourcing risks, disaster and infrastructural utilities failures, political and government risks

Some of the other common types of risks are as follows. *Liquidity risk* –it is the risk that a company or bank may be unable to meet short-term financial demands; it usually occurs due to the inability to convert a security or hard asset to cash without a loss of capital and/or income. *counterparty risk* – it is the risk to each party of a contract that the counterparty will not live up to its contractual obligations; *interest rate risk* –it involves the probability of a decline in the value of an asset resulting from unexpected fluctuations in interest rates. It is mostly associated with fixed-income assets (e.g., bonds); *currency risk*- it is the potential risk of loss from fluctuating foreign exchange rates when an investor has exposure to foreign currency or in foreign-currency-traded investments; *volatility risk* – it is the risk of a change in price of a portfolio because of changes in the volatility of a risk factor. It usually applies to portfolios of derivatives instruments, where the volatility of the underlying is a major determinant of prices**.**

IV. The Basel Story

The Basel Committee on Banking Supervision (BCBS) is a committee of banking supervisory authorities that was established by the central bank governors of the Group of Ten countries in 1974. It provides a forum for regular cooperation on banking supervisory matters. The Basel Committee on Banking Supervision (BCBS) aims to stem the decline in bank capital and sets the guidelines for worldwide regulation of banks. Its objective is to enhance the understanding of key supervisory issues and improve the quality of banking supervision worldwide. Although the BIS does not occupy itself with the implementation of regulation, its reputation and influence is of such nature that its recommendations are considered as the best practice(Basel,2014).

The Basel Capital Accord was launched in 1988 and it became a global standard by which the financial soundness of the banks is assessed. The Basel I Capital Accord represented the first step towards risk-based capital adequacy requirements. Under the rules of the Basel I accord, the minimum regulatory capital associated with loans or other cash assets, guarantees, or derivative contract is calculated as:

Regulatory Capital = Risk weights x Exposure x 8% = Risk- weighed-Assets x 8%

In the above formula, the constant 8% is the minimum ratio of regulatory capital to total Risk-Weighted Assets (RWA).

Basel I capital accord was later considered as risk insensitive as it does not measure risk on a portfolio basis. Basel I did not look beyond credit risk until the mid 1990s.

In 1999, Basel Committee issued a consultative document introducing three pillars-improving the framework for calculating capital adequacy, developing a process of supervisory review and strengthening market discipline. In 2001, Basel II Capital Accord was implemented. It focused on the enhancement of the stability and reliability of the international financial system through the three pillars. In Pillar 1, for minimum regulatory capital requirements, three categories of risks were considered and methods to measure risk for these categories were proposed. i) M*arket risk* : the Standardized Approach and the Internal Models Approach, ii) *Operational Risk :* The Basic Indicator Approach, the Standardized Approach and the Advanced Measurement Approach, c) .*Credit Risk* -The following methods can be used to determine credit risk: The Standardized Approach, The Foundation Internal Rating Based Approach and the Advanced Rating Based Approach. The Standardized Approach provides improved risk sensitivity compared to Basel I. The two rating based approaches, which rely on banks' own internal risk ratings, are considerably more risk sensitive. In Pillar 2, for supervisory review of capital adequacy it was proposed that national supervisors must ensure that banks develop an internal capital assessment process and set capital targets consistent with their risk profiles. Pillar 3 focuses on market discipline and disclosure and promotes the development of financial reporting about risks. It sets out disclosure requirements and recommendations in several areas. The objective of risk regulation is to make market participants better attuned to risk to address the issues on proactive basis rather than addressing those when crisis arises.

Basel III, the 'extreme conservative face' of its predecessor, Basel II, reiterated that the banks should carefully include other risks into their risk calculations and management particularly operational risk. With gradual upgradation of Basel norms, it is indicated that as risk complexities increase, wider and prudent management is called for and more risk types are covered within the Basel ambit. The traumatic experience of the financial crisis of 2007-2008 worked as an eye opener to emphasize the requirement of increasing bank liquidity and decreasing bank leverage so that bank run is avoided. In order to provide adequate high-quality liquid assets base Basel III introduced 'Liquidity Coverage Ratio'. This was to address total net cash outflows over past 30 days and Net Stable Funding Ratio requiring available amount of stable funding to exceed the required amount of stable funding over a one-year period of extended stress [2]. Attempts were also made to reduce procyclicality and promote countercyclical buffers through a series of measures through improved calibration of the risk functions, which convert loss estimates into regulatory capital requirements.

The document on Post-Crisis Reforms Summary (BCBS, December, 2017), also known informally as Basel IV[3] focused on excessive variability of RWAs. It recommended enhancement of the robustness of approaches for estimating credit risk and operational risk and complementing the risk-weighted capital ratio with a finalized leverage ratio and a revised and robust capital floor.

V. Features of Financial risk :

The Basel norms were stipulated for promoting risk awareness and managing risk on a proactive basis as a general guidance. However, risk management also entails appropriate risk insight to foresee risk alert and customize risk management accordingly. Some features of risk especially financial risk are discussed as follows.

a. Risks often overlap, and magnify

For any organization, risk exposure may be sourced from several directions. Any one type of risk may overlap with or get transmitted to any other type of risk. This magnifies the total risk exposure. Specifically during financial stress, risks integrate. Market participants become panic-stricken, therefore markets move in tandem resulting in a speedy transmission from one type of risk to the other. The 2008 debacle initially originated from operational risk, which gradually surfaced in the form of credit risk, and finally expressed itself through widespread market risk.

b. Risk perspectives vary across organizations

Market players such as traders, speculators, hedgers, investors etc., financial institutions like banks, MFs, insurance companies or corporate firms have different risk perspectives. All these entities have their own purpose and nature of functioning and perceive risk from their respective positions.

c. Risk appetites differ

Although market participants are, in general, taken to be risk averse, there are instances when for various reasons participants may become risk neutral or risk lovers. Sometimes greed or fraudulent motivations make persons risk lovers; or there may be over speculation or wrong speculation. Many financial mishaps bear the history of risk loving attitude of the participants.

d. Risks vary among different financial products

Different financial products bear different financial risks. Between the two major financial products, equities and bonds, the former being fully market dependent, is much more risky than the latter. Bonds bear interest rate risk, which is largely policy determined. Mutual fund products are diversified and therefore less risky, though the degree of risk depends on the composition of the product. Derivatives like forwards, futures, and options are mostly exposed to market risk and basis risk. Forwards are also exposed to counterparty risk. Apart from these plain vanilla types, there are exotic derivatives like swaptions, with features of swaps and options, whose operations are complex.

While there is a plethora of financial products floating in the market with a wide array of investment opportunities, knowledge of their risk features is a necessity for construction of portfolio and making strategic decisions. This brings the importance of measuring financial risk as discussed in the following section.

VI. Risk Measurement Issues :

Risk measurement methods simply assess the probable loss that can take place in a pre specified time horizon. The purpose is to capture the existing scenario and to have an apriori assessment of probable future loss. Value at Risk has initially emerged as an important tool for risk assessment. The introduction of VaR as an accepted methodology for quantifying market risk, and its gradual adoption by bank regulators, prove a landmark in the evolution of risk management discipline. VaR has been applied initially in securities houses and later extended to commercial banks and corporate . Introduction of Risk Metrics in October 1994 by JP Morgan[4] (Morgan,1994) initiated a widespread use of VaR. Risk Metrics is a methodology that contains techniques and data sets used to calculate the Value at Risk (VaR) of a portfolio of investments. For estimating credit risk, in particular, credit VaR has been formulated. It was felt that for a greater reliability of loss assessment, VaR must be combined with other risk management tools. Back Testing and Stress-Testing methods have emerged as risk management add-ons. Overtime, the experience of several market disasters raised questions on the efficacy of VaR measure in capturing extreme events. To capture extremities in market movements, Extreme Value Theory has emerged which focuses on the tail distribution. Apart from market risk and credit risk, another major risk category is operational risk which addresses risk through operational mechanism of an entity and is discussed in a separate section..

a. Value at Risk (VaR) :

Value at risk is a statistic that measures and quantifies the level of financial risk within a firm, investment portfolio, or position over a specific time horizon. It works by decomposing all assets of the portfolio into relevant risk factors (factors relevant for its valuation) and simulating their behavior, re-value the entire portfolio. Such factors can be foreign exchange rates, credit spreads, equity prices, equity indices, implied volatility etc. This approach concerns market risk factors and how do they affect the daily performance of a portfolio. One of the basic aims of the alternative methodologies of VaR is to forecast the actual loss which is likely to occur for a given probability level with a chosen time horizon. There are three key elements of VaR –a specified level of loss, a fixed time period over which risk is accessed and a confidence level. VaR can be specified for an individual asset as well as for the portfolio assets. Basel prescribed three times VaR as a safe capital buffer. However, Value at Risk as a measure of market risk has its value only if it is based on a thorough knowledge on how risk measures are calculated and how they are related to actual performance**.** (Duttachowdhury and Bhattacharya, 2015)

VaR can be calculated using the following methods:

i) Delta Normal Method- (parametric)

This method assumes that asset returns are multivariate normally distributed with mean return zero and portfolio return is linearly dependent on all asset returns. Historical data is used to measure the major parameters: mean, standard deviation, and correlation. The advantages of this method lie in its simplicity in terms of matrix multiplication calculation and utilizing standard mathematical properties of normal distribution. However, because of the assumption of normality in return distribution, fat tail in the distribution, a non-normal feature, may not be recognized. Further, VAR is not applicable for futures, options etc. whose returns are non-linear functions of risk factors. (see Technical Appendix)

ii) Historical simulation(non-parametric)

It is the method of predicting future returns depending directly upon the past empirical returns. The underlying assumption of this method is that, future asset returns of a particular stock follows the same distribution as that of the historical price of that stock. Future scenarios are generated based on the behavior of the market variables during each of the N days under consideration and probable loss is estimated accordingly[5]. Being non-parametric, no assumption is imposed on the distribution of parent population and on the estimation of volatilities. Fat tail of the return distribution is also revealed. However, the estimation method carries the features of the past in predicting the future values, which may not always reveal the true nature of probable future values. (see Technical Appendix)

(ii) Monte Carlo Simulation (non-parametric)

It is the most sophisticated and powerful approach to estimate the VaR model. It is a mathematical technique, used in financial and other markets, involving repeated simulation of a system with random sampling from probability distribution of real life processes. Sufficient number of repetitions, called iterations, is required to arrive at a statistically viable result- usually the average value of a parameter. (Muntean, 2004). In financial markets, a model can be described by the elements such as share prices which have a past history and a known probabilistic behavior. In this type of method, one can randomly generate many scenarios and calculate VaR of the portfolio. It is a forward-looking estimation of volatilities rather than the historical volatilities over a period. (see Technical Appendix)

b. Credit Value at Risk (CVaR)

It provides a measure of a portfolio's risk or worst loss expected for given changes in the value of debt. This is caused by probable counterparty default or deterioration of that counterparty's credit worthiness over a given period of time with a given probability. Furthermore, correlation among the assets on the portfolio is an important aspect here. This type of technique most closely concerns debt portfolio with longer horizons over a given period with a given probability. The purpose is to examine the loss probability distribution and estimate the loss level that is being apprehended to occur in a small fraction of the cases. If the losses are larger than this threshold level, the bank defaults. The cornerstone of this methodology is the knowledge of the probability distribution of the bank's portfolio. Bruncl mentions that "the probability that the bank's portfolio suffer losses larger than the sum of expected and unexpected losses is equal to the confidence level, suppose 99.9%.' (Brunel, http://vivienbrunel.free.fr/Other/CreditVaR.pdf) Based on this, Credit Value at Risk (CvaR) is defined as follows.

$$P[L < CVaR99.9\%] = 99.9\%$$

The 99.9% threshold is interpreted as the survival probability of the bank upon the time horizon considered, meaning that its default probability is 0.1%. This threshold depends, of course, on the rating aimed by the bank.

The two methods to estimate CvaR are parametric VaR and Monte Carlo simulations. In parametric CVaR, it is assumed that the economic capital is a multiple of the standard deviation of the credit losses. The parametric CvaR depends on the standard deviation of the loss on each line of the portfolio and on the correlations between each line. (See Technical Appendix)

The second method consists in generating the loss distribution by direct Monte-Carlo simulations and in finding the loss level corresponding to the confidence level 99.9%. Here the Monte-Carlo simulation is applied to compute the loss distribution and the relevant indicators. The process works through estimating the defaults and losses over each obligor of the portfolio, generating the correlated defaults and loss given defaults, then computing the losses at the transaction level and adding them at the portfolio level. The steps are repeated several times.

c. Back Testing:

Back testing is a statistical procedure designed to check whether the real losses are in line with VaR forecasts (Jorion, 2007). One of the basic tests, such as Kupiec's test (1995), (Halilbegovic ,2016) known as Proportion of Failure (POF) test, estimates the frequency of losses in excess of estimated VaR with a pre-selected confidence level (See Technical Appendix). This test is basically dependent on the number of holding days when actual portfolio loss has exceeded the VaR estimate. Jorion (2001) refers Back Test as 'reality checks'. The null hypothesis is that the observed failure rate is equal to the failure rate suggested by the confidence level. The major advantage of this method is that it incorporates nonlinear positions in the calculation of VaR and is also flexible in using any probability distribution.

Back test methods can be unconditional and conditional. Unconditional method estimates the number of VaR exceptions and compares them with the confidence level. If the number of exceptions is within the statistical limits, the model is accepted and otherwise rejected. Conditional method tests whether the VaR violations observed at two different dates are independently distributed. If the number of VaR exceptions is less than the selected confidence level, it signals overestimation of risk and too many exceptions reflect underestimation of risk. The likelihood ratio test based on differences between the actual profit and loss distribution with the VaR numbers boils down to the statistical interpretation on whether the number of exceptions are reasonable or not. According to Hendricks (1996), it is hard to find a suitable VaR model, when the market movements are not steady over the sporadic period.

d. Stress Testing

Stress testing (Licak,2006) is commonly referred to as evaluation of a bank's financial position under severe but plausible scenarios. Risk captured by VaR is measured under a certain hypothesized probability. Severe stress imposing events with low probability are to be addressed separately. A stress test is a “what if” scenario that assumes a major change in one or more relevant variables which create stress in order to see what effect this would have on an entity or the concerned system. It is used to assess the resilience of the financial system to extreme events by simulating exceptional or extreme but plausible shocks to identify ‘weak spots’, which mirrors the risk profile. Stress tests are flexible and forward-looking and can be used both at the micro and macro level.

There are three basic approaches for stress test: Sensitivity Test, Scenario Analysis (Hassani, 2016) and Contagion Analysis. Sensitivity test assesses the effect of a large change in one single risk factor, for example increase in the probability of default by 20 %, change in interest rates, foreign exchange rates, change in interest spreads etc. In the scenario approach, risk scenarios are perceived in various ways. Historical simulation applies historical events to current portfolios, for example, recession in the early 1990s or historical adverse price movements during the past ten years. Hypothetical risk scenarios can also be perceived like adverse shocks in net open position in foreign exchange. While the Sensitivity Analysis does not capture dependencies, Scenario Analysis assumes simultaneous changes of several risk factors and considers correlation effects which capture dependencies among risk factors. In Contagion Analysis, contagion across the system is specifically perceived and therefore Macro Stress Testing Methodologies are applied. While simultaneous risk factors are considered in scenario analysis, in contagion, spread or spillover of the risk across different entities and economic sectors are focused. Exposures within the financial system may transmit shocks from one bank to other institutions thereby producing “domino-effects”. Some contagion scenarios are ‘bank run’ in the interbank market, failure of payment systems etc. Macro Stress Testing Methodologies as usually undertaken are the following. a) Time-series and panel-analysis, b) Vector Auto Regression (VAR) approach, where feedback effects among different financial and macro variables are incorporated, c) Structural model in which models are built based on structural relationship among the macroeconomic variables and d) Integrated approach which undertakes integrated risk factors to analyze functioning of stress generated in a comprehensive risk circuit.

The methodologies are, however, subject to limitations. There are data constraints and the stress scenarios based on historical data may not be severe enough for the purpose. Further, in stress situations, correlations between risk factors are likely to change. Scenarios and interpretation of the results are intuitive. Robustness of the stress testing models are questionable as statistical relationships tend to break down during crises. Among the alternative methods, the integrated approach acknowledges the feedback from the financial sector to the macro-economy, which is important for monetary policy decisions and banking supervision.

e. Extreme Value Theory

The capability of the existing risk management techniques to capture extreme eventualities was put to question following the outbreak of several market disasters. Extreme Value Theory (EVT) has emerged out of this particular concern to provide a firm theoretical foundation for modeling extreme events. The basic problem in VaR is normality assumption of the marginal return distribution, which underestimates tails and its nature in the distribution and extremes do matter. Du Mouchel (1983) has described EVT as having the quality of "Letting the tails speak for themselves".

Studies on EVT have flourished during the last two decades[6]. While application of EVT is not foolproof, it provides a relatively safe method for extrapolating beyond what has been observed (Embrechts et al., 1997). Two popular measures along this line are Value-at-Risk (VaR) and Expected Shortfall (ES). In order to capture the effect of market behaviour under extreme events, EVT has been widely adopted in VaR estimation in recent years. Expected Shortfall measures the mean of the losses that are equal to or greater than VaR. For capturing extremities in the market, EVT has been widely adopted in VaR estimation in recent years**. (s**ee Technical Appendix)

VII. Operational Risk

The collapse of the U.S. financial system in September 2008 and its impact on the world financial system has indicated a serious lack of risk insight. Increasing sophistication in financial products and technologies has introduced complexities and inter-dependencies among financial services. Various events highlight that the scope of risk management for financial services companies extends beyond the traditional risks like credit risk and market risk. In addition, recent publicized frauds and control failures have served to underscore growing focus on the identification and inter-dependencies among financial services (Professional Risk Managers' International Association, 2009, Ramadurai et al., 2004). Virtually every major loss that has taken place during the past 20 years, from Enron, Worldcom and Barings Bank to the subprime credit crisis, has been driven by operational failure initially. Lack of understanding the importance of operational risk is observable in the low capital charge allocated to this risk relative to other risks (e.g., 15% to 20% of total economic/ regulatory capital). Many view operational risk as just back-office operations risk, and executives generally believe that Operational Risk Management (ORM) is fundamentally about managing control weaknesses in the processes at a tactical level. In fact, when the banking industry was confronted with this "boundary issue" several years back, the Basel Committee ruled that credit losses originally driven by operational failure were to be treated as credit losses for capital adequacy purposes. This compromise ruling, had the ultimate effect of diminishing the importance of operational risk — not just in banking but across all industries that followed suit. Under this narrow definition, operational risk was associated with a low capital charge; therefore, many banks viewed it as a low-priority issue. Not only did this divert resources and management attention away from this major risk, but it also blurred the underlying causes of many of the larger losses.

Operational risk is basically a potential 'catch all' that includes human errors or defalcations, loss of documents and records, ineffective systems or controls and security breaches as well. In fact, it permeates all aspects of the risk universe — that is to say it overlaps with and exacerbates all other types of risks, such as market, credit, liquidity and underwriting risk and most of others. In fact, in the absence of operational failure, the other risks are much less significant. ORM is a decision-making tool that helps to systematically identify and minimize risks in order to reduce mishaps, preserve assets, and safeguard the health and welfare of a business entity. In order to achieve effective risk management, proper allocation of responsibilities among front, middle and back office, and high-level risk oversight is a necessity. One may even argue that most of the 'disasters could have been prevented had these three groups adequately performed their checks and balances and communicated effectively among themselves across products and risk types.' (Rahl and Essenghier, 2002)

VIII. Measuring Operational Risk:

Operational risks are dynamic, continuously changing with business strategy, processes, technology, products, and market conditions. Thus, a company's own historical data may not be representative enough for estimating current and future risks. Most cost-effective strategies for mitigating operational risks involve changes to business processes, organization, and personnel. This necessitates a modeling approach that can measure the capital to be held for dealing with operational risks. Basel formulations for estimating capital charge have been evolving to match the changing scenario. The initial approaches involve the following.

Basic Indicator Approach (BIA) is an approach to calculate operational risk capital under the Basel II Accord, and uses a bank's total gross income as a risk indicator for the bank's operational risk exposure and sets the required level of operational risk capital.

Capital requirement = α% of gross income, where Gross income = Net interest income + Net non-interest income and α is the regulatory coefficient .

***Standardized Approach (SA)*-** It divides banks' activities into a number of standardized industry business lines each with its own operational risk charge.

Capital charge $i = \beta_i$ x exposure indicator $_i$, where i and β_i indicate business line and regulatory coefficient respectively.

Overall capital charge = sum of requirements for each business line specific indicator reflecting size of activity in that area.

***Advanced Measurement Approach (AMA)*-** This approach uses a bank's own internal model of operational risk measurement to assess the capital requirement. It combines both qualitative and quantitative standards. For the former, organizational requirements to create an independent operational risk function is considered. A combination of internal loss data, based on a minimum observation period, potential tail loss, if any, external data and scenario analysis using expert opinion are required for estimating the quantitative measure.

***Loss Distribution Approach (LDA)*-** In this approach, expected loss function and operational Value at Risk are estimated on the basis of the distribution of historical loss events. By applying statistical methods for modeling the loss distribution, capital charge of a bank for operational risk capital is calculated using a Value-at-Risk measure.

***Scenario Generation Approach*-** It involves loss scenario simulation modeling.

***Key Risk Indicators approach (KRI)*-** In the operational risk context, a key risk indicator or KRI is a metric that provides information on the specific risk whose exposure it represents at a particular point in time. A primary benefit of using KRI lies in their ability to link current 'real time' exposure levels to risk appetite. By monitoring a set of appropriate risk indicators and by checking their actual values and trends against agreed limits/thresholds, an organization is able to see whether its operational risk exposures remain within its appetite for risk or exceeds it. The use of risk indicators also supports effective governance by providing a transparent and consistent means for tracking both risk exposures and management activity (Institute of Operational Risk, 2010).

Standardized Approach that stands in between the Basic Indicator Approach and the Advanced Management Approach had later been modified and calibrated and given more importance in the ORM procedure. During the financial crisis, bank financial performance resulting in lower Gross Income (GI) challenged the underpinning assumption that revenue, and more specifically GI, was the most effective proxy for operational risk. Based on the qualitative and quantitative analysis, the BCBS has identified the Business Indicator (BI) as the most suitable replacement for GI. The BI comprises the three macro-components of a bank's income statement: the 'interest component', the 'services component', and the 'financial component'. The compositions are as follows:

Interest component = Absolute value (Interest Income – Interest Expense),

Services component = Fee Income + Fee Expense + Other Operating Income + Other Operating Expense

Financial component = Absolute value (Net P&L on Trading Book) + Absolute Value (Net P&L on Banking Book)(BCBS,2014).

Many of these components proved to be at the core of the financial crisis.

The increased effectiveness of the BI as a proxy is also well supported by statistical analysis. In order to synchronize capital requirement with the changing scenario, need for calibrating regulatory coefficients was felt. The recalibration of the current regulatory coefficients in the Basic Indicator Approach (alpha) and the Standardized Approach (betas) focused on three aspects: (i) the review of adequacy of operational risk capital levels; (ii) re-assessment of the need for having different regulatory betas based on the business lines; and (iii) introduction of the new size-based regulatory coefficients.(BCBS,2014).

The BCBS has later developed a quantitative model based on bank-internal loss data, known as the Operational risk Capital-at-Risk (OpCaR) model. This tool can be used to estimate hypothetical capital requirements reflecting own-loss experience. The Committee estimated the amount of capital required to fully cover the exposure to operational risk as reflected in loss experience and the pertinent OpCaR. Apart from the under calibration revealed by the analysis, it was observed that capital needs for operational risk increase in non-linear fashion with the bank's size, suggesting the need to introduce a set of different regulatory coefficients based on the size of the bank as reflected in the value of the BI. The preliminary calibration has identified a five-bucket structure with coefficients increasing in value from 10% to 30% with the rise in the value of the BI. The revised SA is based on two inputs – (i) the BI, and (ii) the regulatory coefficients applied in a layered manner. Banks using the SA must hold capital for operational risk calculated according a specific formula. (see Technical Appendix)(BCBS,2014).

IX. Systems Overview of Risk Assessment

The discussion on operational risk reveals that it has an all-encompassing character covering most of other types of risks. Further, the linkages among the functional parts of any organization or among the organizations through which risk may permeate are well highlighted. Managing operational risk for each of the sources therefore has to follow different channels in an organization considering various layers and dimensions of operations. This generates a need for a holistic approach in overviewing the problem. Risks can originate from different sources in a system and get transmitted to other areas and get magnified. Looking into the banking crisis of 2008, it crystallizes that it was caused not so much by technical failures as by failures in organizational culture and ethics (Moore et al, 2010). Each of the operational risk sources indicates different dimensions of an enterprise, which is a multinodal entity. When the source is the 'people', risk comes through human error or lack of awareness or lack of ethical standards. When the source is 'processes', it is a block in the flow process of internal channels which may be arising out of lack of coordination among the departments. If the risk source generates from the 'systems' it is the lack of holistic risk perception, which disregards the system interactive forces relevant to the specific features of the organization. When the source is 'external events' coming as shocks, it is the lack of business resilience.

The technical factors generating the 2007-2008 financial crisis, as observed by the risk professionals, were easy availability of global capital, excessive leverage and faulty accounting standards which permitted over valuation of assets. Though risks were apprehended, individual or collective greed, fuelled by remuneration practices encouraged excessive risk taking. The motive can be explained by inadequate organizational cultures and lack of risk ethics. Specifically, these cover vision, values, management style, and operating principles. In terms of operational risk, the risk here was sourced from people with a lack of risk ethics. Falling short of holistic perception, system functioning was gradually disturbed. The disruptive force manifested itself in the form of credit risk and thereafter market risk.

It is in this backdrop that the paper proposes that risk analysis should have systems approach to perceive risk in totality. This approach of having a systems overview facilitates the functionalities of each of the sub -categories of the whole system as well as their reflection on the whole system appearing through interactive mechanism among the sub –categories. The approach is fruitfully applicable in risk studies due to the transmission nature of risk. Some discussion on systems approach will clarify the argument.

Systems are recognized as integrated wholes of their subsidiary components 'but never as mechanistic wholes of parts in isolable causal relations'(Lazlo,1972. p.15). Thus, the approach recognizes 'complexes of elements standing in interaction' (Bertalanffy,1971.p.32). Systems are hierarchical in nature with sub-systems building up to systems, which in turn build the super system and finally the net qua system. The entire structure represents a 'systems tree'. The components maintain regular relationships among themselves and the nature of such relationship characterizes the system design.

Every system is a subsystem in a larger context but not to the same degree. (Bowler, 1981) Therefore, the interactions take place between the polarities of relationships called system dominance and system autonomy. Balance of the system is maintained through smooth interactions among the subsystems. Smoothness of systems flow refers to adequacy and efficiency so that all entities, including the nodal entities mutually interact to nourish each other. If systems are unbalanced to hinder interactions among the operational units, risks set in. For the lack of systems overview, there arises a tendency to identify wrongly the symptoms as diseases and treat these accordingly. (Bhattacharya, 2001)

In the context of the analysis of financial risk, systems may be visualized in several ways as follows. In a micro set up, an individual financial entity, e.g. a bank may be taken as a system under which there are different departments as subsystems all of which are functionally related. Any operational malfunctioning or inefficiency in any subsystem in peoples, processes and system will manifest system wide in the form of any of the risk types. In a wider framework, the entire banking system may be taken as a macro system within which banks are considered as sub systems. Therefore, a single bank is a system so long as its internal departments are concerned, but a sub system as one of the banks in the whole banking system. Similarly, for a firm, a single firm is a system having several departments as its subsystems, but is itself a subsystem as one of the firms under the industry to which it belongs. In this way, one can perceive a complex network of functional units linked to each other thus establishing the systems concept of 'relational universal' (Bowler, 1981 p.218**)**. It now becomes clear that systems approach adopted in operational risk analysis enables a risk analyst to have a multilayered system linked overview of the risk scenario. Though the three basic risk types need to be recognized and addressed separately for proactive measures, it has been acknowledged in the literature that some emphasis on operational risk enables to have a feel of most of the different types of risks much ahead of time.

X. Concluding observations :

Risk Management as has evolved as a discipline overtime presently occupies a prime position in all organizations. With growing financial complexities, newer risks are being identified. Correspondingly, researches on risk assessment and guiding principles are continuously being upgraded to capture the reality. This paper provides an overview of the process of risk management coming in the forefront of business practices. Beginning with the discussion on the necessity of addressing prominent financial risks through citing some risk disaster scenarios, the paper classifies some major types of risk. After briefly summarizing the Basel issues, some features of financial risks are mentioned to provide an insight into the risk domain. The paper then shifts on to focusing measurement of market risk, credit risk and operational risk. Operational risk, given its nature, is highlighted here. Probing deep into the matter one can understand that the status of market risk or credit risk or any other type of risk is realized when an entity in concern is already in the serious risk zone or at least approaching the red zone of the risk traffic signal. Operational risk, on the other hand, indicates an early warning signal of upcoming risk of various types. The paper proposes to undertake a systems approach for the purpose. The systems analytical framework has the capability to detect or apprehend the risky mode of operation quite ahead of time. Financial crisis of 2008-09 is a case in point. In the Indian context also, several bank fraud cases, particularly in 2018[7] reflect inadequate risk oversight and lack of risk ethics and risk culture in the operations which came into the surface much later in the form of credit risk and market risk.

In order to avoid disastrous risk episodes, business entities need to enforce effective corporate governance, which discourages short term risk taking and encourage the development of risk management capability. Whatever regulatory changes are introduced, a more rigorous supervision of the effectiveness of internal risk management under system theoretic framework, and adherence to the risk management culture and ethics within firms is required. This would enable organizations reduce their own risk probability as also the risk impact on others thus contributing to the building up of well functioning macro system with adequate risk awareness. Such a system is also more efficient to handle external shocks, if any.

With the expanding varieties of financial products providing a wider array of investment options, financial risks are also undergoing changes in their profiles. Accordingly, researches on risk management need to upgrade the risk management toolkit and the authorities need to revise capital requirement and accounting rules, re-examine the role of rating agencies with the recognition and reconsideration of financial supermarket theory. Risk management, as a discipline, that has evolved over the last few decades needs to go a long way in synchronization with the local and global financial risk scenario.

Notes:

[1] Basis Risk: Basis risk arises when the instrument used to hedge an exposure fails to act as predicted and most frequently occurs when using futures contracts.

[2] The original Basel III rule from 2010 required banks to fund themselves with 4.5% of common equity (up from 2% in Basel II) of risk-weighted assets (RWAs). Since 2015, a minimum Common Equity Tier 1 (CET1) ratio of 4.5% must be maintained at all times by the bank. Capital requirements have been cautiously structured by increasing the minimum capital requirement base and a top up of capital buffers. The minimum Tier 1 capital increases from 4% in Basel II to 6 over RWAs. This 6% is composed of 4.5% of Common Equity Tier I (CET1), plus an extra 1.5% of Additional Tier 1 (AT1). For additional capital buffers, the mandatory part ,capital conservation buffer, comprises 2.5% of risk-weighted assets. Banks have to hold a total of 7% (4.5 % + 2.5 %) CET1 capital ratio, from 2019 onwards. Discretionary part of counter-cyclical buffer" ranges between 0% and 2.5% of RWA and must be met by CET1 capital. This was further revised in the proposed Basel III norms which asked for 7–9.5% (4.5% + 2.5% (conservation buffer) + 0–2.5% (seasonal buffer)) for common equity and 8.5–11% for Tier 1 capital and 10.5–13% for total capital**.** A non-risk-based minimum leverage ratio has been introduced by Basel III.. The ratio is obtained by dividing Tier 1 capital by the bank's average total consolidated assets (sum of the exposures of all assets and non-balance sheet items). The banks are expected to maintain a leverage ratio in excess of 3% under Basel III (BCBS ,2017)

[3]The implementation date is 1 January 2022, with the output floor phased from 1 January 2022 to 1 January 2027

[4]J.P. Morgan and Reuters teamed up in 1996 to enhance the methodology and make data widely available for practitioners and the general public. The aim of Risk Metrics is promoting and improving the transparency of market risks, creating a benchmark for measuring risk and providing clients with advice on managing market risks.

[5] The initial step of the method is to prepare profit and loss of the current portfolio which is affected by market factors for each of the last N days, i.e. N sets of hypothetical market factors are generated using their current values and the changes in the last periods for N days. N hypothetical mark to market portfolio values as well as the corresponding profits and losses on the portfolio are calculated on the basis of the market factors.

[6] Numerous research studies have analyzed the extreme variations that financial markets are subject to, mostly because of currency crises, stock market crashes and large credit defaults. The tail behavior of financial series has, among others, been discussed in Koedijk et al. (1990), Longin (2001), Danielsson and de Vries (2000), Neftci (2000), McNeil and Frey (2000) and Gencay et al. (2003).

[7] PNB scam, Rotomac case, SBI fraud case, RP Infosystem scam, Karnataka Bank fraud case, United Bank of India etc.

References:

Basle Committee of Banking Supervision (1996), Supervisory Framework For The Use of "Back-testing" in Conjunction With The Internal Models Approach to Market Risk Capital Requirements, (pp. 1-15). www.bis.org.

Basle Committee of Banking Supervision (2014) . Consultative Document Operational risk – Revisions to the simpler approaches October. https://www.bis.org/publ/bcbs291.pdf

Basle Committee of Banking Supervision (2017) . BCBS Hiigh Level Summary of Basel III reforms December 2017. https://www.bis.org/bcbs/publ/d424_hlsummary.pdf

Bertalanffy, L. Von (1971). "An Outline of General Systems Theory" *British Journal of Philosophy of Science 1 (2) p 134-165*.

Bhattacharya, B. (2001). Human Development, Poverty, Migration and Urban Informal Sector in West Bengal : A Systems Approach. New Delhi : Allied Publishers Limited in collaboration with DSA Centre for Regional Economic Studies, Department of Economics, Jadavpur University, Kolkata.

Bowler , T. Downing (1981). General Systems Thinkings: Its Scope and Applicability. New York: North Holland.

Danielsson, J., De Vries, C.G., (1997). Value at Risk and Extreme Returns. Working Paper, London School of Economics, London, UK.

DuMouchel WH (1983) . "Estimating the Stable Index á in Order to Measure Tail Thickness: A Critique." *Ann Stat 11(4):1019–1031).*

DuttaChowdhury, P & Bhattacharya, B. (2015). Estimation of Value- at- Risk (VaR) in the Context of Global Financial Crisis of 2007-08: Application on Selected Sectors in India. *Indian Journal of Research in Capital Markets, 2*(2), *7-25*.

Embrechts, P., C. Kluppelberg and T. Mikosch (1997). Modelling Extremal Events for Insurance and Finance. Berlin: Springer,.

Gencay, R., Selcuk, F., & Ulugulyagci, A. (2003). High Volatility, Thick Tails and Extreme Value Theory in Value-at-Risk Estimations. *Insurance: Mathematics and Economics, 33(2), 337–356*

Halilbegovic, S (2016) "Backtesting Value at Risk Forecast: The case of Kupiec Pof-test." European Journal of Economic Studies 17(3).

Hassani, Bertrand (2016) Scenario Analysis in Risk Management . Springer.

Hendricks, D. (1996), "Evaluation of Value-at-Risk Models Using Historical Data", *Economic Policy Review, vol.2, no.1, April* .

Institute of Operational Risk (2010). Operational Risk Sound Practice Guidance: Key Risk Indicators, November.

Jorion, P. (2001), Value at Risk : The New Benchmark for Managing Financial Risk, 2nd Edition, United States: McGraw-Hill

Jorion, P. (2007). Value at Risk: The New Benchmark for Managing Financial Risk, 3rd Edition. New York: McGraw-Hill

Koedijk, K. G., Schafgans, M. M., & De Vries, C. G. (1990). The Tail Index of Exchange Rate Returns. *Journal of International Economics*, *29*(1), *93-108.*

Kupiec, P. (1995), Techniques for Verifying the Accuracy of Risk Management Models, *Journal of Derivatives, 3*(2), 73-84

Lazlo, Ervin (1972). The Systems View of the World. New York: Braziller

Licak, Marek. (2006). "Stress Testing as a Risk Management Method. *BIATEC*, *Volume XIV, 3/ 2006*

Longin, F. (2001). Stock market crashes: Some Quantitative Results Based on Extreme Value Theory. *Derivatives Use, Trading and Regulation*, *7*(3), *197-205*.

Muntean, Cornelia (2004). "The Monte Carlo Simulation Technique Applied in Financial Market", *Economic Informatics*, *1-4, p. 113-114.*

Moore et. al. (2010) . "Risk Minds: 2009 Risk Managers' Survey: The Causes and Implications of the 2008 Banking Crisis". Curzon & Company. www.moorecarter.co.uk/RiskMinds%202009%20Risk%20Managers%27%20Survey%.

McNeil AJ, Frey R (2000). Estimation of Tail Related Risk Measure for Heteroscedastic Financial Time Series: An Extreme Value Approach. *Journal of Empirical. Finance*, *7, 271 – 300.*

Morgan, J.P. (1994). Risk Metrics. https://www.investopedia.com/ask/answers/041615/what-riskmetrics-value-risk-var.asp

Neftci, S. N. (2000). Value at Risk Calculations, Extreme Events, and Tail Estimation. *The Journal of Derivatives*, *7*(3), *23-37.*

Professional Risk Managers' International Association (2009). "Operational Risk : Survey of Approaches and Implementation Practices" , September .

Rahl, L and Z. Essenghier (2002). "Measuring Financial Risk in the 21 st Century" in Risk Management: An Introduction (ed . K. Sithapati) ICFAI University, p. 4.

Ramadurai,K., Olseon, K, Andrews, D, Scott, G., and Beck, T. (2004) "The Oldest Tale but the Newest Story: Operational Risk". Special Report, Fitch Ratings, January.

Vivien, Brunel . "Credit Value at Risk (CVaR)" http://vivienbrunel.free.fr/Other/CreditVaR.pdf

Technical Appendix

Value at Risk (VaR)

Assuming that stock returns are normally distributed, mathematically VaR of a portfolio is calculated as follows:

$VaR(p) = \alpha * \sigma_p * \sqrt{(\tau)}$ Where, α = confidence level under Normal Distribution

σ_p = portfolio standard deviation, τ = the holding period.

Delta Normal Method

VaR of a portfolio is defined as

$$VaR(p) = \alpha * \sigma_p * \sqrt{(\tau)} \text{ -------------------------(1)}$$

Where, α = confidence level under Normal Distribution

σ_p = portfolio standard deviation , τ = the holding period.

The calculation of σ^2_p is based on matrix multiplication between the weights of individual asset in the portfolio and the correlation among the returns of different assets included in the portfolio , The expression is as follows-

$$\sigma^2_p = (\omega^T \Omega \omega)$$

where ω is N X 1 matrix of portfolio equal weights vector, pre and post multiplying variance covariance matrix Ω.

Historical Simulation Method

Calculation of VaR at α confidence level is done in the historical simulation method by generating a profit and loss scenario, which is sorted out by denoting $\Delta V(1)$, $\Delta V(2)$, ... $\Delta V(n)$ in a descending order, where $\Delta V(i)$ is the difference value of a market variable on day i and i-1 simulated trials (i= 1,2------n). VaR under Historical Simulation method is the required percentile rank calculated as below:

$VaR = -\Delta V(k)$ where $k = n * \alpha$ (n as ‘n’ days of historical data, α as level of confidence)

Under this method also we use the same formulation as in equation (1) in Delta Normal method.

Monte Carlo Simulation Method

In Monte Carlo Simulation a random number generator is used to produce tens of thousands of hypothetical changes in the market. These are then used to construct thousands of hypothetical profits and losses on the current portfolio. Multivariate Normal Distribution is used here with the given variance-covariance matrix based on the Delta Normal Method and zero mean of the stocks to simulate the stock returns 100,000 times. Then calculation of the VaR of each stock and the VaR of the portfolio are done by using these returns. The variance-covariance matrix of stock returns generated by the Monte Carlo Method are then given as :

$$\Omega_{\text{Monte Carlo}} = \begin{pmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{pmatrix}$$

Monte Carlo VaR = 0.01 percentile of scenario x total invest x $\sqrt{}$ days

Under this method also we use the same formulation as in Delta Normal method.

Credit VaR (C VaR)

Let σ_i be the unitary standard deviation of line *i* and ρ_{ij} the loss correlation between line *i* and line *j*. We get :

$$EC = k\sqrt{(\Sigma_i \sigma_i^2 + 2\Sigma_{i<j} \rho_{ij}\sigma_i\sigma_j)}$$

The coefficient k is called the capital multiplier and is calibrated in order to be consistent with the 99.9% Threshold.

Back Testing

Under POF (proportion of failure) X denotes number of exceptions; T denotes total number of observations. Failure rate is defined as (X/T), this failure rate ponders the selected confidence level.

We have the number of exceptions 'X' ~ B (T, p) with the pmf (probability mass function) $f(x) = {}^{T}C_x\, p^x (1-p)^{T-x}$. As the number of observations increase the Binomial Distribution can be approximated with Normal Distribution

$$Z = \frac{X - pT}{\sqrt{p(1-p)T}} \sim N(0, 1)$$

The null hypothesis for the POF test is $H_0 : p = X/T$ vs. $H_1 : p \neq X/T$

According to Kupiec (1995) the POF test is best conducted as a likelihood ratio LR test.

$$LR_{POF} = -2\ln \frac{(1-p)^{T-X}\,(p)^{X}}{\{1-(X/T)\}^{T-X}\,(X/T)^{X}}$$

$\sim \chi^2$ with 1 degree of freedom

Under null hypothesis if the model is correct LR_{POF} is asymptotically Chi square distributed with one degree of freedom (d.f) and if LR_{POF} > chi square$_{tab}$ then the model is rejected.

Extreme Value Theory

Expected Shortfall measures the mean of the losses that are equal to or greater than VaR. For capturing extremities in the market, EVT has been widely adopted in VaR estimation in recent years.

EVT can be applied to find a VaR estimate with the 'q' quantile which is as follows

$$VaR_q = u + \frac{\hat{\beta}}{\hat{\xi}}\left[\frac{n}{n_u}\{(1-q)^{-\xi}\} - 1\right]$$

where 'u' is a threshold point, β is the estimated scale parameter and ξ is the estimated shape parameter, n is the sample size, n_u is the number of exceedances beyond the VaR values. Therefore, based on EVT VaR values ES can be formulated as

$$ES_q = \left[VaR_q + \frac{\beta + \xi\,(VaR_q - u)}{(1-\xi)}\right]$$

ORM Standardized Approach

Banks using the SA must hold capital for operational risk calculated according to the following formula.

K*SA* = [Σyears1-3 Σ (BIj X αj)]/3

where

KSA = the capital charge under the revised SA

BIj = annual value of the BI apportioned to bucket "j" (1…n) in a given year

αj = coefficient for bucket "j"

Artha Beekshan, Volume 27, No.4, March 2019

On Inclusive Growth in India*

Arup Mitra#

Abstract

Inclusive growth refers to creation of 'decent jobs' or employment in productive work with adequate and regular earnings.This paper seeks to explain whether the productivity of our labour force engaged in the formal and informal sectors of our economy and employment potentiality has improved or not. It discusses labour force participation and its determinants with the help of Panel Data econometrics and examines the link between skill formation, productivity and employment.

Key words :Inclusive Growth, Labour Force Participation, Skill Formation , Employment and Productivity.

JEL Classification Codes: C23, J 21, J 23, J 48.

I. Introduction

Inclusive growth refers to creation of 'decent jobs' or employment in productive work with adequate and regular earnings. In the informal economy, which for many it is the 'employment of the last resort', the situation of excess-supplies-limited-demand holds strongly, leading to large scale underemployment. A large majority of the work force is engaged in the informal sector in India. While almost the whole of agriculture is under informality, the non-farm activities both in the rural and urban areas are characterised predominantly by the presence of the informal sector. The informal sector offers a wide range of jobs starting from manufacturing, construction and transport to petty trade and services. However, jobs within the informal sector are primarily of residual type, characterized by low productivity. The wages vary widely across activities; hence, one may find a multi-modal wage distribution within the informal sector. Residual absorption, low labour productivity, meager earnings and poor hiring conditions add up to what is called as the lack of 'decent' employment.

Even though the formal sector employment increased during the period 2004-05 to 2011-12, the percentage increase of informal employment within the formal sector was considerable, implying an increasing tendency towards informalisation and casualisation of the work force. Empirical studies have also noted that profitability of organized manufacturing sector in

---

*Keynote paper , presented at the 39th Annual National Conference of Bangiya Arthaniti Pariashad,Kolkata, March 9, 2019.

#Professor of Economics, at IEG, Delhi and Director General, NILERD ,New Delhi.
Email :arup@iegindia.org

India was driven largely by the reduction in wage costs and reduction in welfare-related expenses on workers.

The informal sector workers and the informal workers in the formal sector do not often hold enough prospects for upward mobility as they lack skill and/or scope for acquiring on-the-job training. In what ways these workers can be empowered so that their productivity can be improved and the scope for upward mobility can be enhanced? In the name of informality the entitlement to minimum wages should not be compromised with. How flexibility, improvement in productivity and creation of 'decent jobs' all three can go together is a pertinent question.

Business subcontracting from the formal to the informal sector is on the rise. In an attempt to keep quality under check the informal sector has started hiring workers on regular basis, resulting in what is called as 'regularity in the irregular sector'. Has it actually resulted in an increase in wages as the employers, as per the theoretical understanding, may be required to offer higher wages to reduce the labour turnover? In other words, whether business subcontracting has led to creation of greater and better jobs, rise in labour productivity in the informal sector and improvement in wages? If so, whether it is a limited phenomenon confined to a few segments within the manufacturing activity or it is a large scale phenomenon? Finally, whether the overlaps among the informal sector employment, migration and poverty are getting dissipated? In what way the advantages of informality can be reaped to create employment and at the same time injustice to labour can be discontinued by offering decent employment are some of the challenges that the Indian economy is confronted with.

II. Labour Force Participation and Its Determinants

The male work participation rates pertaining to all age groups are relatively high and are nearly 50 per cent both in the rural and in the urban areas if we consider the main or usual principal status workers (Table 1 for all-India). Secondly the inter-state variations measured in terms of coefficient of variation are limited (17.5 and 15.5 per cent in the rural and urban areas respectively). On the other hand, the female participation rates are significantly lower than their male counterparts (Table 1 for all-India) and more so in the urban areas, implying that the rural-urban differentials in the case of women are more pronounced than in the case of males. Besides, the inter-state variations are sizable in the case of females, reflecting the influence of economic, social and cultural factors (coefficient of variation being 53.2 and 36.0 per cent in the rural and urban areas respectively). The participation rates in the north-eastern and the southern regions for example are considerably higher than the northern states. A relatively lower magnitude of variation in the urban areas may be taken to signify the possibility of convergence (to a limited extent though), while the dominance of the social factors in the rural areas can be said to be more prominent. But the interpretation can be quite erroneous: the female work participation rates being by and large lower in the urban areas than in the rural areas indicate the limited impact of education on participation in the face of social factors. In fact, why the participation rate of Indian urban women is still so low, given that the per capita income and the educational attainment levels are higher than their rural counterparts, is an important research question. The plot of participation rates against per capita income is not suggestive of any significant positive relationship in the case of females though among males such a pattern can be somewhat deciphered (Mitra and Okada, 2018). In relation to females only a subset of the observations at the most may conform to this pattern.

The labour force participation rates (usual principal and subsidiary status) of age groups 15 and above also show marked differences between the male and females both in the rural and urban areas (Table 1, Labour Bureau). Further, the urban female specific rate is even lower than the rural rate. Besides, the inter-state differences both in the rural and urban areas are much wider than their male counterparts.

Table 1: Work Force Participation Rate (WFPR) and Labour Force Participation Rate (LFPR)

Category	WFPR (%) Population Census-2011	LFPR (%) Labour Bureau-2011-12
Rural Male	41.6 (17.5)	79.4 (6.4)
Rural Female	16.7 (53.2)	33.9 (48.0)
Urban Male	48.7 (15.5)	73.7 (7.6)
Urban Female	11.9 (36.0)	19.1 (46.9)
Persons Rural	29.5	57.9
Persons Urban	30.9	48.0
All Males	43.8	77.9
All Females	15.2	30.0
All Persons All Areas	29.9	55.4

Note: (1) Though the Labour Bureau (LB) estimates refer to the year 2011-12 – close to the population census year, 2011 - they are not comparable with each other because the population census estimates are work participation rates for all age groups covering only the main (equivalent to the usual principal status) workers whereas the LB estimates are for age groups 15 and above and they cover all workers (usual principal and subsidiary status) and those who are unemployed.

(2) Figures in parentheses are coefficient of variation based on the state level data.

Source: Population Census, 2011 and Labour Bureau, 2011-12.

Panel Data Analysis

Since Labour Bureau has supplied data for five time points corresponding to each of the states and union territories we have tried to carry out the panel data analysis. But in this exercise only a limited number of variables such as per capita income, the sectoral shares in gross state domestic product and the infant mortality rate could be included.

The results from Table 2 indicate that the female participation rate in the rural areas is influenced by industrialization. The rural diversification possibly creates more opportunities in which women workers can step into. The service sector on the other hand reduces participation refuting some of the popular views which suggest about women's preference to work in this sector. The residual activities carried out in this sector with meager earnings can discourage women from participating in the labour market ('discouraged dropouts'). However, the female health condition measured in terms of infant mortality rate is a strong determinant of their participation both in the rural and in the urban areas (Table 2).

For rural males none of the variables turns out to be significant though in the fixed effect model (FE) the overall growth index is statistically significant (Table 3). The positive effect of industry and services are evident in the case of urban males, across all the three models (classical OLS, Fixed Effect and Random Effect).

So for participation to improve, industrialisation is a prerequisite, and secondly high productivity activities within the services sector will also have to expand significantly. Besides, the health infrastructure must increase to provide easy accessibility to women in particular.

Table 2: Regression Results for Labour Force Participation Rate: Panel Data Analysis (OLS Results)

Variables	Dep var: LFPR(F, R) (OLS)	Dep var: LFPR(M,R) (OLS)	Dep var: LFPR(F,U) (OLS)	Dep var: LFPR(M,U) (OLS)	Dep var: LFPR(F,R) (OLS)	Dep var: LFPR(F,U) (OLS)
PCNSDP	-0.00002 (-0.28)	-0.0001 (-1.84)	0.0001 (2.22)*	-0.00005 (-1.70)	-0.0002 (-1.81)	-0.00002 (-0.39)
%INDP	0.5 (3.54)*	0.069 (1.29)	-0.29 (-1.39)	0.24 (2.62)*	0.69 (4.73)*	-0.22 (-1.09)
%SERDP			0.40 (-1.97)*	0.19 (2.17)*		-0.41 (-2.07)*
%AGDP	0.25 (0.80)	-0.073 (-0.61)			0.35 (1.08)	
IMR among girls					-0.43 (-3.61)*	-0.42 (-5.96)*
Constant	17.93 (1.69)	78.78 (19.56)	45.67 (3.13)*	56.81 (8.95)*	34.40 (2.70)*	68.25 (4.66)*
Adj R2	0.09	0.02	0.19	0.04	0.23	0.24
N	154	154	154	154	122	122

Table 3: Regression Results for Labour Force Participation Rate: Panel Data Analysis (Fixed Effect and Random Effect Models)

Variables	Dep var: LFPR(F,R) (FE)	Dep var: LFPR(F,R) (RE)	Dep var: LFPR(M,R) (FE)	Dep var: LFPR(M,R) (RE)	Dep var: LFPR(F,U) (FE)	Dep var: LFPR(F, U)	Dep var: LFPR(M,U) (FE)	Dep var: LFPR(M, U) (RE)
PCNSDP	-0.0001 (-0.95)	-0.0002 (-1.7)	0.0002 (3.32)*	-0.00001 (-0.22)	0.0001 (0.80)	5.98e-06 (0.07)	-00006 (-1.04)	-0.00005 (-1.54)
%INDP	0.37 (1.28)	0.57 (2.83)*	-0.47 (-1.15)	0.06 (0.81)	0.25 (0.49)	-0.26 (-0.93)	1.26 (4.16)*	0.34 (2.63)*
%SERDP					0.49 (0.92)	-0.32 (-1.18)	1.11 (3.72)*	0.28 (2.23)*
%AGDP	-0.24 (-0.35)	0.34 (0.83)	-0.11 (-0.63)	0.03 (0.20)				
IMR among girls	-0.69 (-4.51)*	-0.67 (-5.43)*			-0.18 (-1.51)	-0.35 (-3.98)*		
Constant	61.35 (3.47)*	48.21 (3.39)*	74.69 (6.58)*	74.74 (13.86)*	-9.18 (-0.21)	60.56 (2.90)*	-22.80 (-0.96)	49.70 (5.48)*
R2	0.06	0.19	0.03	0.03	0.01	0.07	0.02	0.04
N	122	122	154	154	122	122	154	154

III.. Skill Shortage

There is a growing body of literature suggesting low level of skill-base of the work force in the developing countries while the technology imported from abroad is highly skill-intensive in nature. Mitra (2009) based on cross-sectional data pursued this particular point empirically. In a globalizing world we assume that invention, transfer and dissemination of technology take place without any time lag, as a result of which countries at different levels of development are able to access the same technology.

The adverse effects of imported technology on performance are assessed in two steps. First, using the concept of frontier production function, we estimate technical efficiency for the aggregate manufacturing sector which is taken to be the performance indicator. In the second step, we examine the association between the technical efficiency of the aggregate manufacturing sector on the one hand and on the other, the percentage of manufactures in total merchandise imports and per capita income.

Based on the cross sectional data for 30 countries from UNIDO the value added frontier function was estimated by Maximum Likelihood Estimate. Based on the frontier function framework technical efficiency index was estimated. This index was then regressed on the import and growth specific variable, i.e., GDP per capita. Results suggest that countries with higher import of manufactures to total merchandise imports are associated with lower technical efficiency levels. This may be taken to interpret that mere availability of technology does not mean better performance. If the available labour resource is poorly skilled, it is natural to witness poor performance in terms of technical efficiency. Hence, skill up-gradation and training and research and development for technological advancement that suits the labour market conditions of these economies, are the two important policy conclusions of this study.

In order to pursue further the point of skill-mismatch we have followed-up the analysis with another exercise. World Development Indicators report for various countries the percentage of manager indicating labour skill as a major business constraint (LABSKILL)[1]. The higher is the percentage figure, the higher is the possibility that the skill factor affects employment adversely. We have tried to relate the skill specific responses to the rate of growth of employment (ROGEMFG) in the manufacturing sector from UNIDO data. Interestingly the skill factor is seen to affect employment growth in the manufacturing sector negatively (Table 4). In other words, higher is the percentage of managers who feel skill has been affecting business adversely, the lower is the rate of growth of employment in the manufacturing sector. All this is indicative of poor skill base of the work force in the developing countries which reduces the pace of labour absorption as labour demand in the face of imported technology is possibly rising only for the high skilled variety.

Table 4: Employment and Skill: Regression Results

Variable	Dep. Var. ROGEMFG
LABSKILL	-0.47 (-1.93)*
INTER	14.30 (2.60)**
Adj. R^2	0.11
N	22

Note: N stands for the number of observations. ** and * represent significance at 5 and 10 per cent levels respectively.

Source: Based on data from UNIDO and World Development Indicators.

Skill formation is an indispensable prerequisite for labour productivity as well as total factor productivity growth. Even if jobs can be generated in the process of growth they may require certain skills and knowledge, which the available labour may not provide. Hajela (2012) argues that a shortage of skills is making more people unemployable in India. There are 17

[1] Berg and Cazes (2007) however point out the serious conceptual and methodological problems associated with the World Bank's Employing Workers Index of the Doing Business indicators and risks of formulating policies on the basis of these indicators.

central government ministries that offer skill development initiatives through school education, institutes of higher learning and specialized vocational training institutes. China, with a similar scale of population and training structure to that of India, has higher labour productivity, indicating higher skills. She argues that India lacks sufficient skilled workers as its existing vocational training system does not target the casual or informal workforce, which constitutes a sizable percentage of India's working population. Froumin et al. (2007) urged that only 16 per cent of Indian manufacturing firms offer in-service training, compared with 92 per cent in China and 42 per cent in the Republic of Korea. The Indian firms that do provide in-service training are 23–28 per cent more productive than those that do not.

The National Skill Development Corporation (NSDC) in India was formed to achieve the target of skilling/up-skilling 150 million people by 2022 by fostering private sector initiatives in the skill development space. To support its various initiatives, NSDC is looking to create an enabling environment by developing a robust research base for skilling. It conducts studies to understand the geographical and sector-wise skill requirements and on various subjects that can influence and enable the skilling environment in India. NSDC reports are prepared for a wide range of sectors such as auto and auto components, banking, tourism, infrastructure and also the unorganized sector. Several studies across countries highlight the mismatch between skill requirement and the quality of labour available. Richardson (2007) suggests the following scheme for classifying skills shortages: ? Level 1 shortage: There are few people who have the essential technical skills who are not already using them and there is a long training time to develop the skills. ? Level 2 shortage: There are few people who have the essential technical skills who are not already using them but there is a short training time to develop the skills

Skills mismatch: There are sufficient people who have the essential technical skills who are not already using them, but they are not willing to apply for the vacancies under current conditions. Quality gap: There are sufficient people with the essential technical skills who are not already using them and who are willing to apply for the vacancies, but they lack some qualities that employers consider are important.

Comyn (2012) reports on recent research into enterprise skill profiles and workplace training practices in Bangladesh's manufacturing industry. Based on data from 37 enterprises across eight manufacturing groups, collected during a study for the International Labour Organization (ILO), he analysed enterprise and sectoral skill intensity and identified key skill issues. This helps prioritize sectors for project-based investments in workplace training and industry skill development. Particularly at a time of significant expansion, any negligence of research and training can affect performance adversely. The research also illustrates the difficulties of using generalized approaches to classifying and comparing skills at the enterprise and sectoral levels. Whilst the concept of skill intensity and the use of occupational classifications may be interesting it does not talk about the relevance of the acquired skill in a particular occupation across other occupations. Without a skill, which has greater applicability across a number of sectors, the bargaining power of the workers and consequently occupational mobility tend to change sluggishly.

Desjardins and Rubenson (2011) throw light on the potential causes of skill mismatch, the extent of skill mismatch, the socio-demographic make-up of skill mismatch, and the consequences of skill mismatch in terms of earnings as well as employer-sponsored adult education/training. The authors have made a distinction between skill mismatch and education mismatch. Two key findings are as follows. First, including supply and demand characteristics in an earning function, it reveals that labour-demand characteristics are more important than labour-supply characteristics in explaining earnings differentials. In other words, skills matter for earnings but only if they are required by the job. Second, the skill content of jobs seems to be an even stronger determinant of participation in employer-supported adult education/ training than educational attainment or literacy proficiency. On the whole, they argue that skill formation is not just a supply side issue; it is just as much a function of work tasks and work organization on the demand side. Policies on skill formation have to take into account both supply and demand. Identifying the mechanisms that help to foster the optimal utilisation of the existing skill base is essential. Otherwise, many workers, even with high qualifications, may lose their skills due to a lack of use, which is an erosion of any investment in education.

In the context of small versus large firms and skill acquisition, Bishop (2012) points out that due to certain characteristics inherent to their small size, small firms generally display greater informality in their learning processes. They cannot normally be expected to learn in the highly formalized and structured ways more often pursued by their larger counterparts. But small firms, too, can and do benefit from formal training. Bishop deals with the concept of "learning architecture" to illuminate the connection between firm size and learning processes.

Education levels to determine skills is a fairly blunt instrument, more so given that the notion of "skill" is socially constructed, but that's another argument and linked to the new National Skills Qualification Framework (NSQF). As far as the question of which skills are important, the argument about the issue of skill shortages and the importance of expansion of the higher education system should go hand in hand. Higher education may bring higher returns on investments only if the person is employed. Also, the analysis of employability of those with vocational type training may bring a different insight into the story of lower returns on investments into vocational training, if the employability is high. Several studies have used education as a base. Based on the evidence in Asia and the Pacific countries, Tilak (2003) observed significant effects of higher education on development. In terms of NSS data, Mehrotra et al. (2013) use educational (general, technical and vocational) attainments to understand the skill levels of the existing workforce. They estimate the skilling requirements, sector-wise, under different scenarios to arrive at a realistic and desirable target and find that the challenge of skill development—both in quantitative and qualitative terms—is enormous and requires a careful policy stance. Mitra et al. (2002) noted that in most of the two-digit industry groups of the manufacturing sector, education, health and other indicators of social infrastructure impacted on the total factor productivity growth much more than the physical or the financial infrastructure. Hence, the quality of human capital is a strong determinant of performance. In the present study on Indian manufacturing, after bringing out certain aspects of sluggish growth in demand for labour, it is important to assess the employability of the existing labour force. There is a view that highlights the supply side factor, pointing to poor human capital formation, reducing the performance indicator, which in turn motivates employers to adopt capital-intensive technology. On the other hand, given the complementary relationship between capital and skill, capital-intensive technology does not necessarily assure optimal utilization of the available technology due to skill shortage. Mitra (2009) noted that imported technology, which is capital-intensive in nature, tends to reduce technical efficiency in the manufacturing sector in developing countries, which could also be due to the unavailability of skilled labour.

Based on the NSS data we have estimated the index of skill mismatch following the methodology of Estevão and Tsounta (2011): Skill Mismatch Index = sigma (j = 1…n) (Sjt - Mjt)2, where, j is skill level, n is the number of skill categories, Sij is proportion of population with skill level j at time t and Mij is proportion of employees with skill level j at time t.

We have also estimated a similar index taking the difference in the proportional distribution of working persons and the unemployed across various skill levels. A third set is estimated by taking into account the proportional distribution across various skill levels of workers in each of the activities and also all workers between the following two time points: 2004–05 and 2009–10.

III.1Results On Skill Mismatch Index

The index representing the difference between the skill level of the population and the workers is estimated at 73.11 (based on table 18), which is quite high. In other words, the difference between the skill levels of the potential labour supply and those already working is sizeable. Of course we need to understand that those who are employed are not necessarily absorbed in demand-induced activities. There are several activities, which are repository of surplus labour, not requiring much skill to be pursued. Hence, those who are working are not necessarily better off compared to the non-workers in terms of skill levels. Even then the mismatch is significant.

The quality of the training institutes and the ITIs need to improve significantly. The poor quality of training provided by the existing institutions in India is widely known. For different kinds of activities in different sectors the extent of skill mismatch needs to be measured and the skill requirements accordingly need to be determined. Based on this information the nature and type of skill imparting institutions will have to be determined. Through various accessible sources the information on availability of various types of skill education, prospects associated with each type and government/corporate support available at the time of acquisition of skill have to be disseminated. For low income households to come forward and make themselves more employable such action plan has to be worked out first.

The other aspect relates to the geographical location of the skill imparting institutions. Unless the low income households both from rural and urban areas are able to access skill employability and transfer of labour from low productivity to high productivity activities would remain unrealised. The nature of urbanisation which has been taking place since 2001 has to be kept in view for selecting the location of the training institutes. A number of census towns have emerged in 2011 census – some of them are located in the vicinity of large urban agglomerations and some are there in the remote areas. The urban activities seem to be spilling over to the rural hinterland and the lack of productive opportunities in the agriculture sector is also compelling labour to pick up marginal activities in the non-farm sector, which are indeed the drivers of new urbanisation trend. Besides many of the medium sized and small towns are in a state of stagnancy and do not have adequate prospects as far as decent employment is concerned. The smart cities are only handful in number, which obviously cannot cater to the needs of the entire country.

The provision of on-the-job training is also important. With increasing contractualisation the employers do not have any interest in providing training to the employees. In such a situation it is indeed a major challenge to empower workers placed at the lower rungs. With labour market deregulation this possibility would look more remote. What kind of institutions can be created to enable labour to face the challenges of labour market flexibility is a pertinent question. Unions of different types of labour (particularly the vulnerable groups such as those who are self-employed and engaged as casual labour groups) need to be created and can be encouraged to set up a platform for strengthening labour employability.

IV.Policy Recommendations

In this paper we have argued that from demand side a number of initiatives will have to be taken in order to improve the magnitude of employment. Diversification of growth away from agriculture to manufacturing and services is one such prerequisite. Within manufacturing the labour intensive components will have to be prioritised. Incentives to pursue domestic innovation and develop appropriate technology can be extended to firms, resulting in employment creation. Given the skill gap and skill shortage in the economy more training institutes will have to be created and the quality of training will have to be improved significantly. The new technology is highly skill intensive; without skilled manpower it will be difficult to operate the technology optimally. Possibilities of on-the-job-training will have to be created. Given the fact that at the lower end a large number of employees are either casual or contractual, such training provisions may not be forthcoming. Hence, employers will have to be incentivised to introduce non-discriminatory training opportunities. Informal mechanisms through which the training coverage of the institutes can be enhanced need to be explored.

References

Berg, J. and S. Cazes (2007), “The Doing Business Indicators: Measurement Issues and Political Implications”, Economic and Labour Market Paper No. 2007/06, ILO, Geneva.

Bishop, D. 2012. “Firm size and skill formation processes: An emerging debate”, in Journal of Education & Work, Vol. 25, No. 5, pp. 507–21.

Comyn, P. 2012. “Skill intensity and skills development in Bangladesh manufacturing enterprises”, in Journal of Education and Work, Vol. 26, No. 4, pp. 1–29,

Desjardins, R.; Rubenson, K. 2011. An analysis of skill mismatch using direct measures of skills, OECD Education Working Papers No. 63 (Paris, OECD).

Estevão, M.; Tsounta, E. 2011. Has the great recession raised U.S. structural unemployment?, IMF Working Paper, WP/11/105 (Washington, DC, International Monetary Fund).

Froumin, I.; Divakaran, S.; Tan, H.; Savchenko, Y. 2007. “Strengthening skills and education for innovation”, in Dutz, M.A. (ed.): Unleashing India’s Innovation: Toward Sustainable and Inclusive Growth (Washington DC, World Bank), pp. 129–46.

Hajela, R. 2012. Shortage of skilled workers: A paradox of the Indian economy, SKOPE, Research Paper No. 111 (ESRC Centre on Skills, Knowledge and Organisational Performance, COMPAS, University of Oxford).

Mehrotra, S.; Gandhi, A.; Sahoo, B.K. 2013. “Estimating India’s skill gap on a realistic basis for 2022", in Economic and Political Weekly, Vol. 48, No. 13, pp. 102–111.

Mitra, A.; Varoudakis, A.; Veganzones-Varoudakis, M.A. 2002. ‘Productivity and technical efficiency in Indian states manufacturing: The role of infrastructure”, in Economic Development and Cultural Change, Vol. 50, No. 2, pp. 395–426.

Mitra, A. 2009. “Technology import and industrial employment: Evidence from developing countries”, in Labour, Vol. 23, No. 4, pp. 697–718.

Tilak, J.B.G. 2003. “Higher education and development in Asia”, in Journal of Educational Planning and Administration, Vol. 17, No. 2, pp. 151–73.

Artha Beekshan, Volume 27, No.4, March 2019

Diversity, Differentiation and Competition: a Reflection on Sustainability*

Sarmila Banerjee#

Abstract

In the context of sustainabilityof an eco-system, this paper discusses the diversity, differentiation and competition, and the points to role of public policy in the achieving the sustainability in the long run.

Key Words : Sustainability, Bio-diversity, Differntiation, competition

JEL Classification Codes : O13, Q 28, Q51, Q 57.

I.Context

The twenty first century is experiencing a number of changes in different fronts. To name a few: population ageing is now a global phenomenon, so are the depletion of natural resources and degradation of the environment; the epidemiological profile is also changing rapidly, unprecedented growth of information technology has connected the globe through the world-wide-web and global connectivity of business with the associated dominance of market mode is paving the path of institutional changes, emergence of public-private-partnership in infrastructure development, gradual conversion of the merit goods like health and education into club goods are gaining popularity every day, and so on. In this rapidly changing atmosphere, along with a few other countries India is growing very fast and getting recognition of an emerging economy. It seems that the Indian economy is adjusting to this transition in a very commendable manner. So, at this juncture it would be very timely to examine the sustainability of this process.

For an eco-system to be sustainable in the long run it should have the ability to accommodate all sorts of diversity, natural, social, economic, cultural and so on as the tolerance for diversity enhances resilience, the ability to withstand the change in environment. The nature of challenge posed on the system is the same for all types of diverseness, irrespective of the specificity of the type. So instead of focusing solely on bio-diversity I would like to discuss different types of diversities faced by the present system and the approach of mainstream Economics to handle this challenge. Attempt would be made to discuss the explicit

---

*Key-note address for the session on Bio-diversity and Sustainable Development at the 39th Annual National Conference of Bangiya Arthaniti Parishad, March 10, 2019,Kolkata

Retired Professor of Economics, University of Calcutta, and former Rajib Gandhi Chair Professor, University of Calcutta

and implicit connections as well as conflicts and contradictions inherent in the approach to appreciate the complexity of this process. An eco-system is defined in terms of all synergistic interactions among societal forces and components of the environment with the focus on preserving all diversity, ensuring space for all species whereas an economic system is defined for a group of agents like consumer, producer, business, government and non-government organizations thriving efficiency and prosperity. So, eco-system approach is holistic in essence whereas economic system is anthropocentric in orientation

Four components that could be identified as connected with the proposed theme are (a) Diversity, (b) Differentiation, (c) Competition and (d) Development; the target is to define sustainable goals through achievable paths. To make the discussion little simple let me regroup the issues as (a) Sustainable Business, (b) Sustainable Economy (c) Sustainable Society and (d) Sustainable Development and examine the presence of compatibility and/or contradiction among the goals pursued by and strategies adopted by each. Business is a part of the economy, where economy is embedded in the society and society is contained in the environment. So, like a typical dynamic optimization problem, our sustainable development path has to have the sustainability property for each sub-theme as well as across sub-themes to ensure the sustainability of the integrated global eco-system. For business and economy the target is to achieve efficiency in both short and long-run and therefore, their path should be sustainably efficient. That means it is long-run profitability ensured through competitive efficiency. For economy “sustainability” strikes a material balance. For society, “sustainability” indicates the assurance of inter-generation equity in terms of available “opportunities”. Here sustainable path is an equitably reproducible path. For environment, “sustainability” means the *absence of vulnerability* or *presence of resilience* against unanticipated shocks which is endorsed by the conservation of “diversity”, both in Society and in Nature.

My intention is to indicate some inherent imbalances created within the system that deserve immediate attention of researchers, practitioners and policy makers, driven by both the (i) objectives pursued by the self-interested agents with specific materialistic aspirations and (ii) regulatory loopholes in specifying the jurisdiction of each agent, leaving no space for the persuasions of overall harmonious coexistence. In economics, the idea of survival is real, meaning someone would die without their *needs* being met. This includes things like food, water, and shelter. A *want*, in economics, is one step up in the order from *needs* and is simply something that people desire to have, that they may, or may not, be able to obtain. When people can spend on their *want*, then it is the *effective demand*. To be able to sustain profitably in the long run, Business adopts strategies to enhance demand, expand market and increase the volume of consumption. If larger markets can be stratified in terms of homogeneous consumers of differentiated products and production can be carried out for each group separately then business can reap the advantage of the economies of scale to gain efficiency.

However, here efficiency reduces diversity and redundancy, both of which are key features of resilience.

II. Diversity and Sustainability

It is important to understand the role played by diversity in ensuring sustainability. Let us take an example from the experience of India's Green Revolution to illustrate the one-to-one linkage between bio-diversity and environmental sustainability. During the sixties of the last century there was acute food shortage almost all over the world. Different public policies were contemplated to enhance food supply. Till that time agriculture was mostly Nature dependent and, therefore, seasonal: seeds were produced in seed-beds, water used to come from monsoon rain, fertilization through bio-degradable manure and pest control was mostly ensured through the predator-prey relationship between pests, rodents and the birds inbuilt in the food-chain. So, all the inputs were non-marketed and a major part of production was for self-consumption. However, with the introduction of High-Yielding-Variety (HYV) technology the entire production process underwent a radical change. The production and productivity increased manifold not only from each harvest, there was a drastic reduction in the length of the cropping cycle and an increase in the number of cycles per season. Nature's constraint in terms of a seasonal bio-geo-cycle was relaxed by technology. HYV-seeds were purchased from the market, at least for the non-monsoon months, water was supplied through ground-water irrigation, both fertilizer and pesticides were chemical products and the crops were very water-hungry. So, all inputs were marketed. Production called for financial investments. Banks were nationalized to extend and expand rural credit. To repay the loan the farmers had to sell the output in the market. If the farmers cultivated diverse varieties of any crop then in market they had to advertise to disseminate information about their product quality. With very little risk-taking ability they found it more convenient to produce more or less uniform varieties. The number of varieties got compromised and market started influencing the cropping pattern; rice and wheat became the major crops because of their higher market values. All of the Green Revolution varieties have basically been, in one way or other, derived from one Japanese wheat strain with the dwarfing gene and Taiwanese rice strain indicating a narrow genetic base. The major risk with this arrangement lies in managing an episode of crop-failure. If there is a pest attack in any field then it would spread over the neighboring fields almost instantaneously, there would be almost no resistance and the situation would turn into an epidemic. Crop-diversity could have helped in resisting the pest attack through better resilience, which would not be possible any longer. So, both the average productivity and the risk of crop failure went up and it had become a choice between *low but certain* vis-à-vis *high but uncertain* return in agriculture (Shiva, 1989).

This is the short-run scenario of vulnerability, but the long-run impact on sustainability is even more disturbing. The linkage between diversity and sustainability is synergistic in nature. In the standing water in crop-fields abundance of fish and other eatables was secured source of food-supply for the farmer households. With the application of chemical fertilizers and pesticides, there is increase in the chemical oxygen demand (COD) of the water that has made it inhabitable for the aqua lives. So the nutrition of the farmers gets affected with its chain reactions manifesting everywhere. Again the extraction of ground water through lift irrigation led to a fall in water table below the aquifer level with an increased risk of soil salinity. In that case the soil would be degraded drastically and almost permanently. In fact, large part of the districts of Western Punjab lost soil fertility after continuous HYV cultivation over a few decades (Singh, 2011). In traditional agriculture the land was left fallow in post-harvest period for some time for it to be revitalized through absorption of crop residues, organic matters and through other natural aerobic processes. However, the new technology encouraged multiple cropping, whereby land was denied adequate time for healing. Having turned agricultural 'farm' into manufacturing 'firm' to carry out factory based simple commodity production and encouraging farmers to produce high-value crops is putting the ecological balance of the entire system into question.

III. Sustainable Business and Over-consumption

The primary concern of a sustainable business is taking appropriate decisions to enhance efficiency, which will be reflected in increased profitability; adherence to the social obligations and environmental regulations are only secondary. Economic efficiency along with economic sustainability is giving birth to the concept of eco-efficiency. Under eco-efficiency the regulatory policies encourage greener innovations to ensure resource conservation and business is interested in producing more output by using less resources. The total volume of production is growing everyday and through different marketing strategies demand is also created for those products. Consequently the rate of real consumption exceeds the rate of consumption needs (Borza, 2014). Since the world population is continuously growing over time the total volume of consumption needed to satisfy basic need is in the rise. Moreover, the desire to consume more is increasing everyday due to the effective promotional plans of the business. According to the World Bank, the highest shares of consumption lie in food and beverage and clothing and footwear. Here the demand hike is ensured through adaptation of the policy of planned and perceived obsolescence, which revolves around design of products. The products are intentionally designed to be discarded after a short amount of time. When it is planned, designers create products that will not be able to work after a certain period of time though they work for enough time to ensure the customers will come back to buy again. Perceived obsolescence comes in a lot with fashion and trends and fueled by advertising and media consumption. Through this technique, consumers are convinced that certain products do not have value anymore because it is out of style, and in order to have value, consumers must buy more up-to-date styles. That is how the concept of fast fashion was born. The business model of fast fashion is based on consumers' desire for new clothing to wear. In order to fulfill consumer's demand, fast fashion brands provide affordable prices and a wide range of clothing that reflects the latest trends. This ends up persuading consumers to buy more items which leads to the issue of overconsumption. This dramatically shortens the consumers' buying cycle. The quick changing stocks and low price of fashion goods encourage consumers to visit the store and make purchases more frequently. The garment industry is taken as an example but the observations hold for almost all aspects of life-style products.

According to Diamond (2008) "the average rates at which people consume resources like oil and metals, and produce wastes like plastics and greenhouse gases, are about 32 times higher in North America, Western Europe, Japan and Australia than they are in the developing world…. The population especially of the developing world is growing, and some people remain fixated on this. They note that populations of countries like Kenya are growing rapidly, and they say that's a big problem. Yes, it is a problem for Kenya's more than 30 million people, but it's not a burden on the whole world, because Kenyans consume so little. (Their relative per capita rate is 1.) A real problem for the world is that each of us 300 million Americans consumes as much as 32 Kenyans. With 10 times the population, the United States consumes 320 times more resources than Kenya does….. If India as well as China were to catch up, world consumption rates would triple. If the whole developing world were suddenly to catch up, world rates would increase eleven-fold. It would be as if the world population ballooned to 72 billion people (retaining present consumption rates)….. We could have a stable outcome in which all countries converge on consumption rates considerably below the current highest levels. Americans might object: there is no way we would sacrifice our living standards for the benefit of people in the rest of the world…. Real sacrifice wouldn't be required, however, because living standards are not tightly coupled to consumption rates. Much American consumption is wasteful and contributes little or nothing to quality of life. For example, per capita oil consumption in Western Europe is about half of ours, yet Western Europe's standard of living is higher by any reasonable criterion, including life expectancy, health, infant mortality, access to medical care, financial security after retirement, vacation time, quality of public schools and support for the arts. Ask yourself whether Americans' wasteful use of gasoline contributes positively to any of those measures."

Table 1: Country-rank in the World Consumer Goods Market, 2015

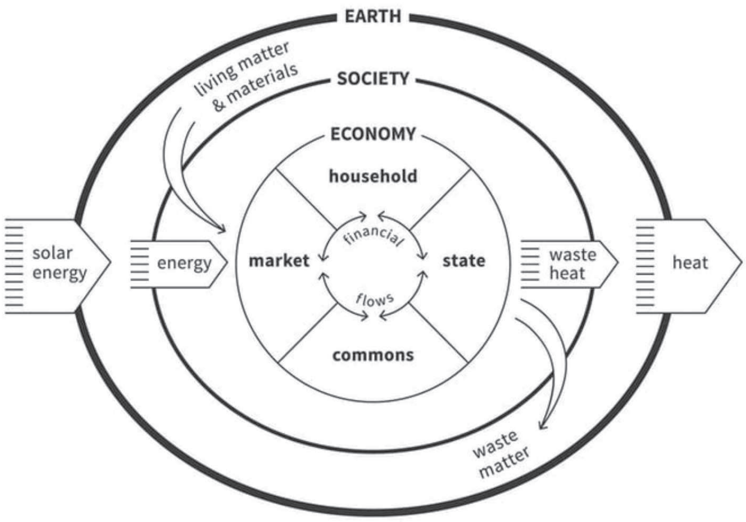
Country	Rank	Consumer market Total (%)	Population Share (%)	Per Capita Consumption Factor with India = 1.0	Rank (PC)
USA	1	29.00	4.27	58.59	2
Japan	2	8.51	1.64	44.76	5
Germany	3	5.29	1.07	42.65	6
China	4	5.29	18.41	2.48	23
France	5	4.45	0.85	45.16	4
UK	6	4.05	0.87	40.16	13
Italy	7	3.65	0.77	40.89	10
Brazil	8	2.38	2.75	7.47	22
Spain	9	2.38	0.60	34.22	15
Canada	10	2.26	0.48	40.62	12
India	11	2.12	17.74	1.00	25
Russia	12	1.93	1.87	8.90	20
Mexico	13	1.67	1.72	8.38	21
Australia	14	1.62	0.33	42.35	8
South Korea	15	1.30	0.67	16.74	16
Turkey	16	1.26	1.08	10.06	19
Netherlands	17	1.05	0.22	41.17	9
Indonesia	18	0.91	3.49	2.25	24
Switzerland	19	0.82	0.11	64.31	1
Poland	20	0.75	0.49	13.20	17
Belgium	21	0.71	0.15	40.83	11
Greece	22	0.69	0.14	42.52	7
Venezuela	23	0.64	0.42	13.15	17
Austria	24	0.59	0.11	46.27	3
Sweden	25	0.57	0.13	37.82	14

Source: Calculated by using data on the 25 Largest Consumer's Markets ... The Outlook, 2015

Table 1 reports the share of top 25 countries in the consumer good market of the World. The rank of each country is given in terms of her absolute volume of transaction. Sweden has the lowest rank with 0.57% share and USA enjoys the top rank with 29% share. China has 5.29% share with rank 5 and India has 2.12% share with rank 11. To standardize the relative position with respect to country-population the same rank has been calculated again in per capita terms. Now the top rank goes to Switzerland followed by the US and the rank of India drops down to the bottom (25). The rank correlation turned out to be as small as 0.076.

The food industry is the other largest sector of consumption and studies show that people waste a fifth of food products just through disposal or overconsumption. The UN Food and Agriculture Organization collected data and found that by the time food reaches the consumer, 9% (160 million tons) goes uneaten and 10% is lost to overconsumption - meaning consumers ate more than the calorie intake requirement. When the consumer takes in too much, this not only explains over production but also lends itself to overconsumption of energy and protein, having harmful effects on the body. Lester Brown of the Earth Policy Institute, has said: “It would take 1.5 Earths to sustain our present level of consumption. Environmentally, the world is in an overshoot mode”. As of 2012, the United States alone was using 30% of the world’s resources and if everyone were to consume at that rate, we would need 3-5 planets to sustain this type of living (Brown, 2011).

Figure 1: Material (Im)Balance – a Caution!



A fundamental effect of overconsumption is a reduction in the planet’s *carrying capacity*. The material balance of the earth would be disturbed and the system would lose its sustainability. More style means more purchases of cheaper and affordable stuffs and we are more likely to dispose these mass-product fashion garments than pricier ones- so increase in the volume of waste (Cline, 2013). In fact, managing waste from these exponentially growing food processing and fashion industries are posing enormous pressure on the absorptive capacity of the system. In 2013, the fast fashion products generated 15.1 million tons of textile waste in the USA, out of which a lion’s share was thrown out in the landfill and the rest was incinerated. In the pre-globalization era this surplus could have been exported to the poorer developing nations where the scarcity of products was a very common feature, but now with enhanced global connectivity, increased tendency towards life-style convergence and short shelf-life of these products, this excess supply would dampen market price, affect the brand image adversely and lower the prospect of future profitability. Thus, over-production and over-consumption are in a never-ending spiral, placing unbearable pressure on both resource base as well as environmental quality of the planet earth. Even when each one of the business houses would stick to its environmental commitment through pursuance of CSR (corporate social responsibility) related obligation sheer scale of total production coupled with ever increasing wave of consumerism would make the system non-reproducible at the aggregate level. Summation of micro-discipline would fail to guarantee the macro-level sustainability.

IV. Differentiation: an Efficient Business Strategy

Only two market models in economics are considered perfect, one is perfect competition and the other is perfect price discrimination. In both these cases the price mechanism produces maximum achievable level of total social surplus with zero deadweight loss, indicator of the highest level of efficiency. In case of former the entire surplus goes to the consumer and for the latter it is all enjoyed by the producer. In this millennium the global economy is integrated through the market institution and here the first degree discrimination (or, marginal utility pricing) is evolving as an effective business strategy where the inherent revelation problem is overcome by introducing menu pricing. Most of the products are collection of a number of attributes and the total price paid is the sum total of compensation paid for each one. By picking up the chosen product from a variety of offers the consumer reveals his/her type through self-selection. The people of same type will select the same variety of product and the market will help in bringing together the birds of same feather by practicing product differentiation. Ultimately price discrimination and product differentiation is dividing the society into a number of homogeneous sub-groups of consumers to reap the benefit of large scale production.

Business efficiency would be interested in enhancing mean (return) and lowering spread (risk). This would necessarily encourage gravitation towards homogeneity and movement away from diversity. In statistical terminology this phenomenon can be described as an increase in between group variance and reduction in within group variance of a stratified heterogeneous population. This greater degree of mean-concentration for each stratum is a definite sign of efficiency enhancement, but in the absence of inter-stratum-interaction it is diversity reducing and less resilient to unanticipated changes as this tendency would eventually create intolerance to social differences. Efficiency works on increasing the average and marginal productivity whereas sustainability banks more on accommodating *interdependent* diversity. Even when through product differentiation diversity is given a prominent place, due to social stratification there is very little interaction across groups and diversity reduces to mere variety. Everyone feels comfortable in his/her own social class and can afford to minimize interactions across social groups through formation of social clubs with a consequent “our-their” type dualism.

Through advertising and other promotional activities globally acceptable life-style for each specific group is being projected and caption like “find your kind of people” is promoted. Here comes in the notion of positional consumption. With the increase in global connectivity and economic progress population mobility has gone up manifold, especially for the skilled ones. In a mobile society there is a need to construct and then reconstruct one’s social identity. Consumption (choice of home, car, clothes, etc.) plays an important role in this process. Positional consumption, which is the consumption not to meet an absolute need (like hunger, thrust, etc.) but rather to create superiority, leads to insatiability. Unfortunately, positional consumption, for example having a more luxurious than average home, car, etc. has become a central feature of the process of identity creation. Once positional consumption is underway, adaptation, a basic element of human psychology, helps push the process along…. It never stops. It is not just the adaptation to a high level of income, but also a pressure of constant increase…it creates a “treadmill effect” that is hard to set off, even when one has become rich. The business also plays on this “consumerism” and makes profit out of it; only the consumer entity of an individual gets nurtured by the system. Business ethics do not hesitate to promote concepts like “neighbor’s envy, owner’s pride”. Thus, the meaning of “living well” reduces to greater and easier access to commodity and it threatens “folk and high culture”, “community and individuality” and “sustainable management of natural resource and environment” (Stutz, 1998).

The threat to sustainability inherent in this tendency to belong to a homogeneous social environment and mixing only with people of one’s own kind can be illustrated with an example from the popular Age Management strategies. The 21st Century is the century of ageing as the World population is getting older with an increase in the average life expectancy (UNFPA 2012). Even in India the person attaining 60 is expected to survive for another 18 years and at 70 the corresponding expected life-span is another 12 years. Aging is a natural phenomenon and it has obvious biological, socio-cultural and psychological implications. In matured age to carry out the basic day-to-day activities one may need external assistance at the physical level. Due to termination of active outdoor interactions as well as lowering of indoor participation in regular chores one feels emotionally lonely and redundant. So, both support-service and human company become more important to the elderly people compared to healthy, matured adults. At ripe and matured age with the on-set of degeneration of physical and mental faculties people become more attached to their hitherto familiar environment, their comfort zone. They become more routine bound and develop some resistance or mental block against change. Their ability to adjust to newer environment, surroundings, people and overall living conditions keep on declining. They feel most comfortable in their habitual niche corner. This propensity is known as place-attachment (Lawton, 1998).

Family being the most vital personal care unit in human society turns out to be the most preferred source of support to almost all elderly persons. A family has demographic diversity and the intergenerational bonding. The younger generation looks after the older ones and the older members also render some useful services related to childcare, social grooming of young boys and girls and other chores that are not physically very demanding, slow in pace but experience-driven and extremely important. It goes consistently with the conventional social norms also. However, these arrangements are more likely to work in a typical joint family structure where the family is an 'extended type' in the sense more than one married couples are living under the same roof sharing same kitchen. For nuclear or incomplete families it is more difficult to accommodate older generation. So, if family fails to provide support to the elderly, then the reason must be searched in the underlying causes of discontinuity of the joint family system itself. The causes may be identified as an advancement of the society from the agrarian to relatively more skill intensive secondary and tertiary activities through the process of industrialization, migration, urbanization and the spread of modern education. In this modern household the traditional man-woman division of labor no longer holds. In the traditional family men were the bread-winners and women used to work inside home as primary caregivers. So, the speed of life was much slower for the women compared to men. Instead in the modern family both men and women are well educated, earning money and conscious about their respective human rights. Both are suffering from scarcity of time, both are facing the stressful environment of the outside world. Indoor family activities are no longer the sole responsibility of the women, the indoor-outdoor division is no longer valid and both are expected to participate in both spheres.

Another important aspect is the space crunch in urban households and difficulty to accommodate elderly members who are more on the receiving side and weaker in giving role. Due to the influence of globalization and information revolution, in a network connected world round-the-clock work across time-zones and frequent mobility of the skilled personnel making it more difficult to attend the elderly members of the family, who are having more sedentary lifestyle. So, to the young couples child-rearing seems more important priority than looking after elderly parents. The faster is the convergence of the structure of the family from joint to nuclear and from nuclear to incomplete, lesser is the likeliness of elderly people to be able to live with their family in the same familiar domestic environment.

As the 'family' as an institution is gradually failing to provide elderly care alternative institutions are continually emerging. Overtime the market is evolving to provide support for elderly care. Number of elderly living facilities, elderly-day-care-centers, home-care services and other support systems are coming up in the market. The concept of active ageing, healthy ageing, productive ageing and life-long-learning are gaining popularity to remove the stereotyping of ageism and contesting the stigma on the elderly people as depressed, ailing and residual class. These markets are thriving by bringing in the elderly people of similar background under the same umbrella. Now the similar kind of elderly persons are socializing and sharing lives among themselves. There are special stores to attend the elderly needs and special facilities to provide care, fun and entertainment to them. They are now physically secured and can interact in a friendly social environment without much tension and coercion. So far, it is an arrangement of convenience. But what are the hidden costs? The major cause of depression for the elderly is now a sense of alienation from the society at large, an acute sense of redundancy. The elderly are socializing with the other elderly people only and not taking any active, meaningful role in the upbringing of the younger generations. Social stratification norm has become a two-way one in terms of socio-economic status as well as age-cohort. It is affecting inter-generational solidarity adversely. Economic affluence is helping them to buy quality care service at the old age but not providing them the sense of security and rootedness that their older generation used to have within the family environment, irrespective of their economic status.

Though this change in the institutional orientation has become very much noticeable in the advanced economies and the upper classes of the emerging economies are also sharing similar experiences, the discussion will be incomplete without a mention of the transitional trauma that the society is experiencing in this change-over process. In fact, the foundation of family relation itself, in terms of its mutually reinforcing give-and-take position for all members, is weakening day-by-day. In the newly evolving relational structure people are suffering from suppressed guilt for not being able to fulfill the expectation of the older generation. This is affecting their relation with their own spouse and children.

V. Learning to Live Well

In 1930, John Maynard Keynes wrote an essay, “Economic Possibilities for our Grandchildren” where he looked 100 years ahead. According to him, by that time the basic economic problem of struggle for existence will be solved and the problem of mankind would shift to “learning to live well”, which would be the permanent problem of the human race. Keynes dreamt of a society where the affluent people will thought of remain economically purposive for others after it has cease to be necessary for oneself. The culture of work-sharing will help to solve this permanent problem of mankind by helping them to learn “live well”. To learn to live well one has to learn to live wisely and live agreeably, where the former focuses on an individual’s position regarding one’s own self and the latter refers to an individual’s position relating to others, including Nature and Environment. Keynes himself admitted that this learning is not at all a simple journey; rather it is extremely complex in nature. It is hard to move from the pursuit of material affluence to a style of life that emphasized "leisure".

On an average the length of working hour is higher for the higher income class and it has gone up over time in the developed world. In the US between 1990 and 2000, the hours worked by each adult member in a two-parent family has gone up from 33 hours a week to 37 hours a week and for the top income quartile this average length exceeds "40 hours a week" norm. The labor supply curve does not experience the backward bend anymore due to the dominance of income effect over the substitution effect at a higher level of earning. It is very common these days to come across an advertisement for a book like "The one minute bed-time story". What is the immediate reaction of a busy, young, executive parent? At the first glance the One-Minute Bedtime series sounds almost too good to be true. Rattle off six or seven "stories" and still finish inside ten minutes- what could be better? Then order will be placed to Amazon for quick shipment of the series….. However, if one thinks sanely, the question may haunt that has my whole life turned into an exercise in a hurry? In packing more and more into every hour? Am I obsessed with saving every last scrape of time- a minute here, a few seconds there? Has the entire society been caught in the same vortex?

"Why do I think of earning in the first place"? The answer is, "obviously to look after the family and to ensure comfort and security for my people". So, it was a means and not an end. However, it has been sown by Maslow (1943) that when all the basic needs are taken care of, sufficient social security is enjoyed and emotional needs are also satisfied one is keeping on earning more and more to enjoy social position of power, importance and respect. Even at the highest income bracket, at the height of their career people strives for more and winning in this rat-race becomes the end and no longer the means. Without very conscious participation there is high chance of getting lost in this materialistic world of over-work and overconsumption. Learning to enjoy leisure in a self-satisfying as well as socially productive manner is a real challenge.

In 1937 at the concluding ceremony of Sri Ramakrishna Birth Centenary celebration a Parliament of Religion was held in Kolkata where there were fifteen sessions on different aspects of the religions of the World. The fifth session was chaired by the famous poet-philosopher Rabindranath Tagore. In his presidential address he explicitly discussed the contradiction between the power of materialism and the concern of sustainability. While the power of material success lies in measurable quantities clearly defined within the boundaries of property rights the sustainable life of self-actualization is represented by a boundless free life achieved through a perfect harmony of relationship not only with human beings but with all creations and not in a mere severance of bondage.

…"The distinctive feature of materialism is the measurability of its outward expression, which is the same thing as the finiteness of its boundaries. … To increase one's own bounds one has necessarily to encroach upon those of others…. The pride of Power is the pride of Quantity"…

… "I hope I do not belong to those, who, born in a prison-house, never have the good luck to know that it is a prison, who are blissfully unaware that the costliness of their furniture and profuseness of the provision of their comfort act as invisible walls in a castle of vanity that rob them not only of their freedom but even of the desire for it"…

… "The perfect freedom is in a perfect harmony of relationship and not in a mere severance of bondage. Freedom has no content, and therefore no meaning, where it has nothing but itself."…

The directions indicated by great thinkers to learn to live well do not lie in increasing consumption and access to material acquisition beyond a certain level. After a limit it will be the reflection of insatiable desire for power and potential cause of conflict.

VI. Concluding Concerns

Before concluding the discussion I must mention the danger through which the world is passing. Here a large portion of the population is still struggling for subsistence and another important part is badly affected by the aggressive attack of consumerism. Given the degree of mismatch between aspiration and local conditions, here, the scope for inculcating proper social values through the designing of suitable public policy seems remote. So, we are facing the challenge of finding out the appropriate Art of Living in terms of both sustainable production as well as sustainable consumption. My intention is to indicate some inherent imbalances created within the system that deserve immediate attention of researchers, practitioners and policy makers. It is important to remember that given the complexity of interactions in Economy, Society and Nature, only micro-level responsible behaviors would certainly be inadequate to guarantee the overall macro balances needed for sustainable development. On the whole the canvas laid out here is highly colorful and we expect the deliberations to bring in thought-provoking suggestions regarding the way-forward.

References

- Borza, M. (2014): *The connection between efficiency and sustainability- a theoretical approach*, Procedia Economics and Finance 15 (2014) 1355 – 1363 Elsevier;
- Brown, L. R. (2011): *World on the Edge: How to Prevent Environmental and Economic Collapse*. Earth Policy Institute. Norton.

- *Cline, E. (2013): Overdressed: The Shockingly High Cost of Cheap Fashion, Penguin, USA*
- Diamond, J. (2008): *What's your consumption factor?* January 2, the New York Times;
- Keynes, J.M. (1930): *Economic Possibilities for our Grandchildren*;
- Lawton, M. P. (1998): *Environment and aging: Theory revisited*. In R. J. Scheidt & P. G. Windley (Eds.), Environment and aging theory: A focus on housing (pp. 1-31). Westport, CT: Greenwood Press.
- Maslow, A. H. (1943): *A theory of human motivation*. *Psychological Review, 50(4),* 370-396.
- Shiva, V. (1989): *The Violence of Green Revolution*, Research Foundation for Science and Ecology, Dehradun
- Singh, P. (2011): *Economic benefits and ecological cost of Green Revolution: a case study of Punjab*, Journal of Economic and Social Development, 7(1), 64 – 74;
- Stutz, J. (1998). *Economic Possibilities for our Grandchildren: Progress and Prospects* after 75 years. In: http://www.tellus.org/documents/stutz.pdf
- Tagore, Rabindranath (1938): Presidential address of the 5th Session in the Parliament of Religion held in Kolkata In 1937 and printed in The Religion of the World in 1938; RMIC, Kolkata.
- UNFPA (2012): Ageing in the Twenty-First Century; UNFPA and HelpAge International;

Artha Beekshan, Volume 27, No.4, March 2019

Quantitative Measurement of District level Vulnerability in West Bengal A Macroeconomic Study

Jyotish Prakash Basu#

Abstract

The paper attempts to measure vulnerability of 18 districts of West Bengal. The paper utilizes 17 macroeconomic variables collected from secondary sources in 2001 and 2011 and find vulnerability indices for all districts using exposure, sensitivity and adaptive capacity of IPCC (2007). The paper identifies more vulnerable, moderate vulnerable and less vulnerable districts of West Bengal based on vulnerability indices. Besides, the paper also attempts to identify the determinants of vulnerability at the district level. The results of the study showed that the more vulnerable districts are Purulia, Bankura, Jalpaiguri and Darjeeling while the less vulnerable districts are West Midnapore, Murshidabad and Hooghly when we assign equal weights in the calculation of vulnerability index. The number of more vulnerable districts has risen in 2011 compared to that of 2001 using equal weights while the opposite picture happen using unequal weights. The determinants of vulnerability are identified as maximum temperature, cropping intensity, main agricultural population, net sown area and poverty. Lastly, the paper has an important policy implication for poverty reduction and climate risk reduction measures.

Keywords : Vulnerability index, adaptive capacity, exposure, sensitivity, poverty, Panel regression,

JELClassification Codes : Q54, O15

I. Introduction

The study of vulnerability is multidisciplinary approach. Different disciplines are engaged in studying vulnerability research. It covers the areas of climate change as well as the other field of research like ecology, public health, poverty and development, sustainability science. India is one of the most climate vulnerable countries in South Asia. In India climate change is considered to be a major obstacle to development (Stern 2007) and likely to affect crop productivity adversely which leading to threatens food and livelihood security. In India 55 per cent of its total working population are engaged in agriculture and contributes 14.1 per cent of gross domestic product. Climate change projections report for India highlighted that an overall temperature would increase by 1–4^{0}C and precipitation by 9–16% towards 2050s

#Professor of Economics, Dept. of Economics,West Bengal State University, Barasat, Kolkata, India;Email: bjyotish@yahoo.com

(Kumar et al., 2011). Different regions are expected to exhibit different amount of rainfall, temperature and another climate related events are the increased frequency of occurrence of extreme events like droughts, floods, cyclones and earthquake and landslides.

The focus of the study is the quantitative measurement of vulnerability to climate change at the district level in West Bengal. The study is relevant because of the fact that most of the development planning and programs are implemented through district level planning in West Bengal. The study is also significant for identifying the districts that are relatively more vulnerable to climate change and sources of such vulnerability, so that the necessary investments can be targeted for development (Rao et al., 2016).

There are various approaches to assessing vulnerability to climate change (Fussel and Klein, 2006; IPCC, 2001a, Metzger and Schroter, 2006) and interpretations of the concept of vulnerability in relation to climate and other environmental changes (e.g., Adger, 2006; Bohle et al., 1994; Holling, 1986; Kasperson et al., 1995; Kelly and Adger, 2000; Smit andWandel, 2006; Wisner et al., 2004).

We follow IPCC Fourth Assessment Report (2007) relating to the meaning of vulnerability. Vulnerability is defined as the degree to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability and extremes (IPCC 2007). Vulnerability is a function of exposure, sensitivity, and adaptive capacity (IPCC 2007). Exposure is interpreted as the direct danger (i.e., the stressor), and affects region's climate variables like temperature, precipitation, extreme weather events etc. Sensitivity is the degree to which a system is affected by a disturbance (Gallopin, 2006) and the adaptive capacity is the ability of a system to cope or recover from the disturbance (Smit and Wandel, 2006).

There are two types of analytical methods like indicator and econometric approaches used for measuring vulnerability. Vulnerability studies based on indicator method are divided into two main branches depending on the use of weights. Some studies (Cutter, Mitchell, and Scott 2000, Hahn et al. 2009) have used equal weights while other studies assigned different weights. There are various methodological approaches have been suggested to calculate the weights, like expert judgment by Kaly and Pratt (2000) ; Kaly et al.(1999), principal component analysis by Easter (1999) ; Cutter, and Shirley (2003) , Abson et. al. (2012), Piya et. al. (2012), correlation with past disaster events by Brooks, Adger, and Kelly (2005), and use of fuzzy logic by Acosta-Michlik et. al. (2005), Eakin and Tapia (2008). Khan et al. (2013) estimated quantitative measurement of human vulnerability index at the block level in PaschimMidnapore district of West Bengal. Das and Das (2017) studied environmental vulnerabilities index in the Indian Sunderbans.

Most of the above studies are related to global, regional and national level measurement of vulnerability based on indicator method. But there are few studies available for the measurement of vulnerability to climate change at the district level.

Given the backdrop, the objectives of the paper set the following;

First, is to measure district level vulnerability indices using equal and unequal weights between 2001 and 2011.

Second, is to identify the districts which are more vulnerable, moderate vulnerable and less vulnerable.

Third, is to estimate the determinants of vulnerability to climate change.

II. Data and Methods

II.1 Data

The study is based on secondary data. Data like maximum temperature, minimum temperature, rainfall, food grains, no. of small farmers, cropping intensity, main agricultural population, net sown area, literacy rates, livestock, farm size, per capita income, length of the road, people below the poverty line and no. of people get medical facilities etc are collected from Census report of 2001 and 2011.

II.2 Analytical method

In calculating the vulnerability index, we have followed an indicator based model used by IPCC. First we convert indicators' values into normalized form which are free from unit and standardized values lie between zero and unity. Before doing this we identify the functional relationship between indicators and vulnerability. There are two types of functional relationships; one is positive and another is negative. The functional relationship is shown in the Appendix A.

For the variables having positive functional relationship with vulnerability the normalized value (X) the following formula:

$$x_{ij}= \frac{X_{ij}-Min(X_{ij})}{Max(X_{ij})-Min(X_{ij})} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Min(X_{ij}) and Max(X_{ij}) are the minimum and maximum values of the j indicator reflecting low and high vulnerability.

For the variables having opposite functional relationship with vulnerability the normalized value (X) of the kth indicator for mth district has been calculated using the following formula:

To normalize such indicators the study follows the formula

$$y_{ij}= \frac{Max(X_{ij})-X_{ij}}{Max(X_{ij})-Min(X_{ij})} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The vulnerability Index is then constructed by i) giving equal weights to all indicators and II) assigning define weights to all indicators.

The Vulnerability Index with equal weights can be measured with the help of following equation

$$VI = \frac{\sum_j x_{ij} + \sum_j y_{ij}}{K} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

The urge of constructing weighted vulnerability index is to provide relative importance to each indicator Measurement of weighted vulnerability index in the present study is constructed with the help of following methodology developed by Iyenger and Sudarshan (1982).

$$\bar{y}_i = \sum_{j=1}^{k} w_j x_{ij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Where $\bar{y}_i$ is the vulnerability Index of the ith individual, w_j is the Weights of jth indicators such that$(0 < w < 1 \text{ and } \sum_{j=1}^{k} w_j = 1)$. Weights are assumed to vary inversely as the variance over the regions of the respective indicators of vulnerability. The weight is determined by

$$w_j = \frac{c}{\sqrt{var_i(x_{ij})}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where c is the normalizing constant such that

$$c = \left[\sum_{j=1}^{j=k} \frac{1}{\sqrt{var_i(x_{ij})}}\right]^{-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The logic behind the choice of weight in such a way so that it would ensure large variation in any one of the indicators would not unduly dominate the contribution of the rest of the indicators and distort inter regional comparison. The vulnerability index so computed lies between 0 and 1, with 1 indicating maximum vulnerability and 0 indicating no vulnerability at all. The functional relationship of the sub-indicators with vulnerability is shown in the Appendix A. The calculated values of unequal weights are presented in the Appendix B.

II.3 Panel regression

We have used fixed effect model the simplest version of the model is as follows

$VI_{it} = c + x'_{it}\beta + \varepsilon it$, i = 1,2, 3,4........17; t = 1,2

Where i stands for the ith cross-sectional unit and t for the tth time period. Here t = 2001 and 2011.

The estimating equation is given by

$$VI_{it} = c + \beta_1 E_{i1} + \beta_2 E_{i2} + \beta_3 E_{i3} + \beta_4 E_{i4} + \beta_5 S_{i1} + \beta_6 S_{i2} + \beta_7 S_{i3} + \beta_8 S_{i4} + \beta_9 S_{i5} + \beta_{10} S_{i6} + \beta_{11} A_{i1} + \beta_{12} A_{i2} + \beta_{13} A_{i3} + \beta_{14} A_{i4} + \beta_{15} A_{i5} + \beta_{16} A_{i6} + \beta_{17} A_{i7} + \varepsilon_{it}$$

Where,

E1 = District wise Average Max temperature (in °c)

E2 = District wise Average Min temperature (in °c)

E3 = District wise Average Rabi season rainfall (in mm)

E4 = District wise Average Kharif season rainfall (in mm)

S1 = District wise Population Density (Persons per Sq. km.)

S2 = District wise Production under Total Food grains (Production in thousand tonnes)

S3 = District wise no. of Small farmers (in persons)

S4 = District wise Cropping intensity

S5 = District wise Main agricultural population (in person)

S6 = District wise Net Sown area (% of geographical area)

A1 = District wise Literacy rate (% of total population)

A2 = District wise total no. live stock (per sq. km)

A3 = District wise % of average farm size

A4 = District wise % of PCI (at constant price 2004-2005)

A5 = District wise Length of Roads (in Kilometer)

A6 = District wise number of people live below poverty line (% of total population)

A7 = District wise number of people get medical facilities (in person)

c = Constant

II.4 Study Area

We have taken 18 sample districts of State of West Bengal like Darjeeling, Jalpaiguri, Cooch Behar, North Dinajpur, South Dinajpur, Malda, Murshidabad, Birbhum, Burdwan, Nadia, North 24 parganas, Hooghly, Bankura, Purulia, Howrah, South 24 Parganas, West Midnapore and East Midnapore. The districts like East Midnapore, South24 Parganas, North 24 Parganas, Howrah & Hooghly are more cyclone prone areas of West Bengal. The districts like Bankura, Purulia, Birbhum and parts of Paschim Midnapore are known as drought prone areas mainly due to deficient rainfall and adverse soil structure. The landslide hazard in West Bengal has been observed mostly in the Darjeeling District and extends a part of Jalpaiguri district. The districts like Malda, Murshidabad, North and South Dinajpur, South 24 Parganas, Howrah and Hooghly are known as flood prone districts of the state.

III. Results and Discussions

III.1 District wise Vulnerability indices with equal weights and unequal weights

The district wise vulnerability indices of West Bengal along with the rank of districts with equal and unequal weights in 2001 are shown in Table 1 and Table 2 respectively. From Table 1 we find that the vulnerability indices are varying from 0.59561 to 0.44725. The districts are ranked on the basis of vulnerability indices where rank 1 indicates most vulnerable district and vulnerability decreases as we move on increasing the rank. It is indicated from Table 1 that the district South 24 Parganas is the most vulnerable district, its vulnerability index is highest (0.59561) and ranks first followed by the district Purulia (0.59125), the district West Midnapur(0.56842), the district Jalpaiguri (0.56210) and so on. The district Nadia is least vulnerable district of West Bengal, its rank is 18 (Table 1).

In terms of exposure, the district East Midnapur ranks first followed by West Midnapur, North 24 Parganas and so on. In terms of sensitivity the district of Purulia ranks first followed by the district South 24 Parganas, the district Darjeeling, the district Howrah and so on. With regard to adaptive capacity the district North Dinajpur ranks first followed by the district Malda, the district East Midnapur and so on.

It is observed from Table 2 that the district South 24 Parganas is the most vulnerable district, its vulnerability index is highest (0.71499) followed by the district Jalpaiguri(0.68620), the district Purulia (0.67787) and so on. It is also found from Table 2 that the ranks of most of the districts in respect of exposure, sensitivity and adaptive capacity have also been changed compared with equal weight.

Table 1: District wise vulnerability index in 2001 with equal weights and their ranks

District	Exposure	Sensitivity	Adaptive Capacity	Vulnerability
Darjeeling	0.31073 (18)	0.61446 (3)	0.38550 (18)	0.44872 (17)
Jalpaiguri	0.63368 (6)	0.47512 (10)	0.59575 (4)	0.56210 (4)
Cooch behar	0.65692 (4)	0.38370 (13)	0.56598 (7)	0.52304 (9)
North Dinajpur	0.62302 (7)	0.30593 (17)	0.72969 (1)	0.55503 (5)
South Dinajpur	0.62302 (8)	0.35227 (14)	0.57170 (6)	0.50633 (11)
Malda	0.60961 (9)	0.34987 (15)	0.68705 (2)	0.54982 (7)
Murshidabad	0.54762 (10)	0.44512 (11)	0.51220 (13)	0.49686 (14)
Birbhum	0.54440 (11)	0.41573 (12)	0.55618 (8)	0.50384 (13)
Burdwan	0.52088 (13)	0.51395 (7)	0.44953 (16)	0.48905 (16)
Nadia	0.54002 (12)	0.26011 (18)	0.55465 (9)	0.44725 (18)
North 24 Parganas	0.66787 (3)	0.55636 (5)	0.48760 (15)	0.55428 (6)
Hoogly	0.48948 (14)	0.48445 (9)	0.53337 (10)	0.50578 (12)
Bankura	0.47802 (15)	0.55035 (6)	0.52475 (11)	0.52279 (10)
Purulia	0.45115 (16)	0.68692 (1)	0.58930 (5)	0.59125 (2)
Howrah	0.44307 (17)	0.57705 (4)	0.44039 (17)	0.48925 (15)
South 24 Parganas	0.64287 (5)	0.64757 (2)	0.52408 (12)	0.59561 (1)
West Midnapur	0.76508 (2)	0.50406 (8)	0.51120 (14)	0.56842 (3)
East Midnapur	0.78314 (1)	0.33070 (16)	0.59673 (3)	0.54670 (8)

Source: author's calculation; Note: Figures in the parentheses represent rank

Table 2: District wise vulnerability index in 2001 with unequal weights and their Ranks

District	Exposure	Sensitivity	Adaptive Capacity	Vulnerability
Darjeeling	0.08932 (18)	0.27718 (3)	0.20667 (18)	0.57319 (15)
Jalpaiguri	0.16561 (6)	0.20627 (9)	0.31431 (3)	0.68620 (2)
Cooch behar	0.16639 (5)	0.16961 (12)	0.26948 (10)	0.60549 (10)
North Dinajpur	0.14699 (7)	0.13005 (17)	0.36721 (1)	0.64426 (7)
South Dinajpur	0.14699 (8)	0.14082 (14)	0.28974 (5)	0.57756 (14)
Malda	0.14668 (9)	0.13980 (15)	0.35265 (2)	0.63914 (8)
Murshidabad	0.12397 (12)	0.19821 (11)	0.24077 (15)	0.56296 (17)
Birbhum	0.12593 (11)	0.16654 (13)	0.27372 (9)	0.56620 (16)
Burdwan	0.11677 (13)	0.23597 (7)	0.24219 (14)	0.59495 (11)
Nadia	0.13100 (10)	0.10846 (18)	0.28488 (6)	0.52436 (18)
North 24 Parganas	0.17516 (3)	0.25125 (4)	0.23901 (16)	0.66543 (5)
Hoogly	0.10964 (14)	0.20207 (10)	0.28173 (8)	0.59344 (12)
Bankura	0.10513 (16)	0.24187 (6)	0.25856 (11)	0.60557 (9)
Purulia	0.09474 (17)	0.29956 (1)	0.28357 (7)	0.67787 (3)
Howrah	0.10596 (15)	0.24968 (5)	0.22933 (17)	0.58498 (13)
South 24 Parganas	0.16912 (4)	0.29052 (2)	0.25534 (12)	0.71499 (1)
West Midnapur	0.20289 (1)	0.22016 (8)	0.25029 (13)	0.67335 (4)
East Midnapur	0.20220 (2)	0.13624 (16)	0.30984 (4)	0.64828 (6)

Source: author's calculation; Note: Figures in the parentheses represent rank

The district wise vulnerability indices in West Bengal along with ranks of the districts in 2011 with equal and unequal weights are presented in Table 3 and Table 4 respectively. It is observed from Table 3 that the vulnerability indices with equal weight varying from 0.68458 to 0.36211. In West Bengal, the district Purulia is most vulnerable district on the basis of highest value of vulnerability index (0.68458) followed by the district Bankura, the district of Jalpaiguri, the district of Howrah, the district of Darjeeling and so on. The districts like East Midnapur and West Midnapur are least vulnerable districts on the basis of lower values of vulnerability indices (Table 3).

In respect to exposure, the district of Purulia ranks first followed by the district Bankura, North 24 Parganas, Jalpaiguri, and West Midnapur and so on. In terms of sensitivity, the district Purulia ranks first followed by the district Darjeeling, the district of Bankura, and the district of Howrah and so on. With regard to adaptive capacity the district Darjeeling ranks first followed by the district Purulia, the district North Dinajpur, the district Malda and so on.

From Table 4 it is found that the vulnerability indices varying from 0.82091 to 0.39145. It is also observed from Table 4 that the ranks of the districts with respect to exposure, sensitivity, adaptive capacity and vulnerability have been changed compared to the ranks with equal weights.

Table 3: District wise vulnerability index in 2011 with equal weights and their ranks

District	Exposure	Sensitivity	Adaptive Capacity	Vulnerability
Darjeeling	0.29541 (18)	0.62601 (2)	0.72451 (1)	0.58878 (5)
Jalpaiguri	0.56620 (4)	0.59270 (5)	0.67053 (6)	0.61851 (3)
Cooch behar	0.47101 (12)	0.43671 (11)	0.59439 (10)	0.50971 (12)
North Dinajpur	0.35360 (17)	0.41327 (12)	0.70267 (3)	0.51840 (8)
South Dinajpur	0.36202 (16)	0.48939 (8)	0.62484 (8)	0.51519 (10)
Malda	0.40598 (15)	0.41003 (13)	0.68740 (4)	0.52329 (7)
Murshidabad	0.47870 (11)	0.40490 (14)	0.46314 (16)	0.44624 (14)
Birbhum	0.49466 (8)	0.49892 (7)	0.61250 (9)	0.54469 (6)
Burdwan	0.52328 (6)	0.35873 (15)	0.47537 (15)	0.44548 (15)
Nadia	0.48498 (9)	0.44339 (10)	0.59021 (11)	0.51363 (11)
North 24 Parganas	0.56765 (3)	0.52036 (6)	0.48611 (12)	0.51738 (9)
Hoogly	0.49472 (7)	0.35266 (16)	0.47783 (14)	0.43762 (16)
Bankura	0.63759 (2)	0.61507 (3)	0.68102 (5)	0.64752 (2)
Purulia	0.67675 (1)	0.65869 (1)	0.71124 (2)	0.68458 (1)
Howrah	0.45003 (14)	0.60495 (4)	0.66631 (7)	0.59377 (4)
South 24 Parganas	0.48402 (10)	0.46031 (9)	0.48139 (13)	0.47457 (13)
West Midnapur	0.54087 (5)	0.34071 (17)	0.36717 (18)	0.39870 (17)
East Midnapur	0.47058 (13)	0.27195 (18)	0.37741 (17)	0.36211 (18)

Source: author's calculation; Note: Figures in the parentheses represent rank

Table 4: District wise vulnerability index with unequal weights and their Ranks in 2011

District	Exposure	Sensitivity	Adaptive Capacity	Vulnerability
Darjeeling	0.08776 (16)	0.27455 (3)	0.33067 (3)	0.69299 (4)
Jalpaiguri	0.14120 (3)	0.26772 (4)	0.31599 (6)	0.72493 (3)
Cooch behar	0.11829 (10)	0.19739 (11)	0.28494 (10)	0.60062 (10)
North Dinajpur	0.08346 (18)	0.18393 (14)	0.34466 (1)	0.61207 (8)
South Dinajpur	0.08656 (17)	0.21722 (8)	0.29503 (8)	0.59881 (11)
Malda	0.09893 (15)	0.18493 (13)	0.33004 (4)	0.61390 (7)
Murshidabad	0.12190 (9)	0.19204 (12)	0.21928 (13)	0.53324 (14)
Birbhum	0.11324 (11)	0.22613 (7)	0.29496 (9)	0.63433 (6)
Burdwan	0.12971 (6)	0.16757 (15)	0.21372 (16)	0.51101 (15)
Nadia	0.12451 (7)	0.20581 (10)	0.27697 (11)	0.60730 (9)
North 24 Parganas	0.13982 (4)	0.23089 (6)	0.21848 (15)	0.58921 (12)
Hoogly	0.12211 (8)	0.15851 (17)	0.21862 (14)	0.49926 (16)
Bankura	0.16617 (2)	0.28440 (2)	0.32615 (5)	0.77673 (2)
Purulia	0.17839 (1)	0.29865 (1)	0.34386 (2)	0.82091 (1)
Howrah	0.11010 (14)	0.25845 (5)	0.30454 (7)	0.67314 (5)
South 24 Parganas	0.11228 (12)	0.21219 (9)	0.22148 (12)	0.54595 (13)
West Midnapur	0.13098 (5)	0.16303 (16)	0.18987 (17)	0.48390 (17)
East Midnapur	0.11170 (13)	0.11961 (18)	0.16014 (18)	0.39145 (18)

Source: author’s calculation; Note: Figures in the parentheses represent rank

III.2 Comparative analysis of district-wise vulnerability

The district-wise rank in vulnerability indices with equal and unequal weights in 2001 and 2011 are shown in Table 5. In 2001 the district South 24 Parganas was most vulnerable (rank 1) district in West Bengal but in 2011 it was less vulnerable (rank13th) district (Table 5). It is also observed from Table 5 that the district Bankura the rank in vulnerability was 10th but in 2011 its rank in vulnerability was second highest while the district Darjeeling its rank in vulnerability was 17th in 2001 but its rank in vulnerability was 5th in 2011. It also appears from Table 5 that the district West Midnapur was more vulnerable district, its rank in vulnerability was 3rd in 2001 while it becomes less vulnerable its rank in vulnerability was 17th in 2011. Figure 1 shows the position of vulnerability with equal weights from 2001 to

2011 across the districts in West Bengal. It is found from Table 5 that most of the districts ranks in vulnerability have changed. For example, the district of Bankura its rank in vulnerability was 2nd in 2011 but its rank was 10th in 2001 (Table 5). Similarly, the district of Darjeeling its rank in vulnerability was 4th in 2011 while its rank was 15th in 2001. Figure 2 shows the position of vulnerability with unequal weights from 2001 to 2011 across the districts in West Bengal.

Table 5: Comparison of vulnerability with equal and unequal weights in 2001 and2011

District	Vulnerability							
	Equal weight				Unequal weight			
	Index		Rank		Index		Rank	
	2001	2011	2001	2011	2001	2011	2001	2011
Darjeeling	0.448722	0.588785	17	5	0.573194	0.692995	15	4
Jalpaiguri	0.562104	0.618518	4	3	0.686203	0.724931	2	3
Cooch behar	0.523047	0.509713	9	12	0.605493	0.600626	10	10
North Dinajpur	0.555034	0.518402	5	8	0.644267	0.612074	7	8
South Dinajpur	0.506334	0.515199	11	10	0.577562	0.598818	14	11
Malda	0.549829	0.523293	7	7	0.639142	0.613909	8	7
Murshidabad	0.496864	0.446248	14	14	0.562966	0.533241	17	14
Birbhum	0.503842	0.544693	13	6	0.566201	0.634339	16	6
Burdwan	0.489058	0.445482	16	15	0.594953	0.51101	11	15
Nadia	0.44726	0.513634	18	11	0.524363	0.607306	18	9
North 24 Parganas	0.554286	0.517388	6	9	0.665436	0.589215	5	12
Hoogly	0.505781	0.437629	12	16	0.593447	0.499261	12	16
Bankura	0.522797	0.647529	10	2	0.605572	0.776735	9	2
Purulia	0.591253	0.684584	2	1	0.677878	0.820919	3	1
Howrah	0.489255	0.59377	15	4	0.584983	0.673143	13	5
South 24 Parganas	0.595616	0.474574	1	13	0.714992	0.54596	1	13
West Midnapur	0.568423	0.398703	3	17	0.673357	0.483905	4	17
East Midnapur	0.546703	0.362117	8	18	0.648284	0.39146	6	18

Source: author’s calculation; Note: Figures in the parentheses represent rank

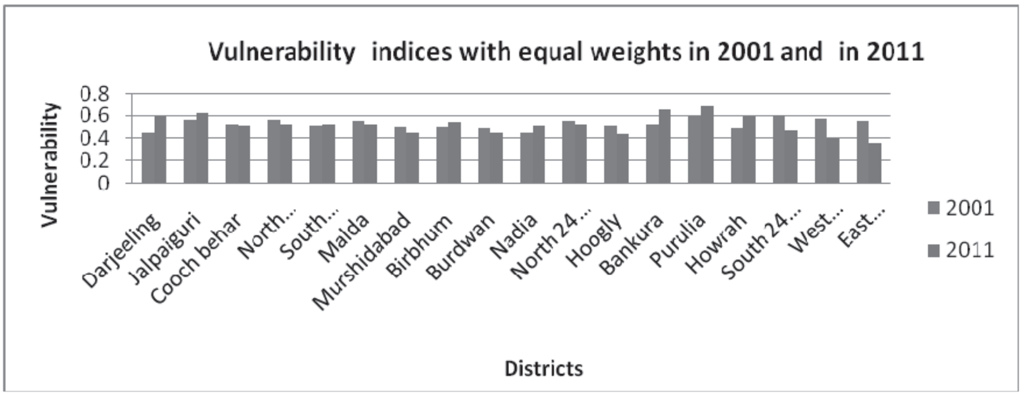


Figure 1 Vulnerability indices with equal weights in 2001 and in 2011

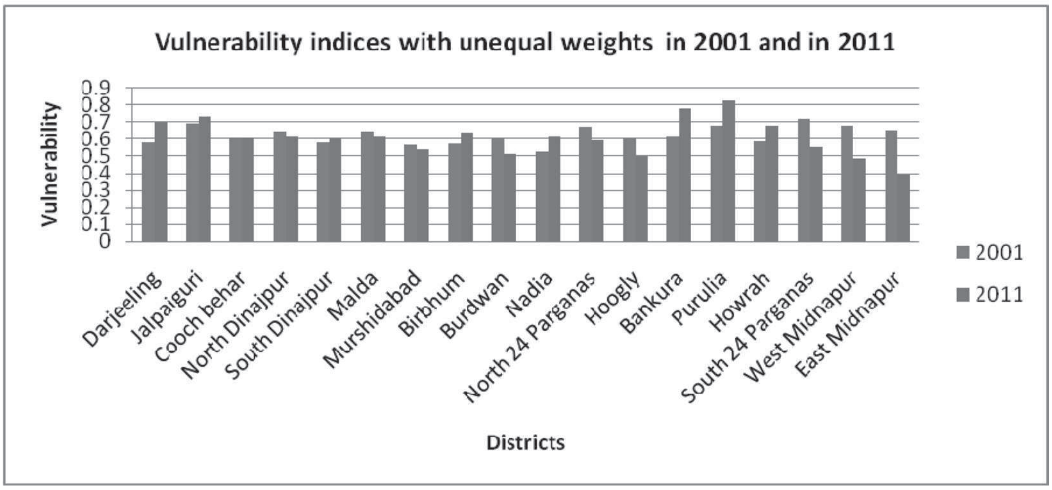


Figure 2 Vulnerability indices with unequal weights in 2001 and in 2011

The distributions of vulnerable districts with equal and unequal weights are shown in Table 6 and Table 7 respectively. The vulnerable district is classified as less vulnerable, vulnerable and highly vulnerable districts on basis of the values of vulnerability indices. It is found from Table 6 that the number of highly vulnerable districts in West Bengal raised from 17% in 2001 to 33% in 2011 while the number of less vulnerable districts fell from 44% in 2001 to 37% in 2011.

Table 6: Distribution of vulnerable districts in 2001 and 2011 with equal weights

Vulnerability Index	Assigned Attribute	No. of Districts	
		2001	2011
≤ 0.5097	Less Vulnerable	8 (44%)	7 (37%)
0.5097-0.5674	Vulnerable	7 (39%)	6 (31%)
≥0.5674	Highly Vulnerable	3 (17%)	6 (33%)

Source: Author's calculation; Note: Figures in the parentheses represent percentage

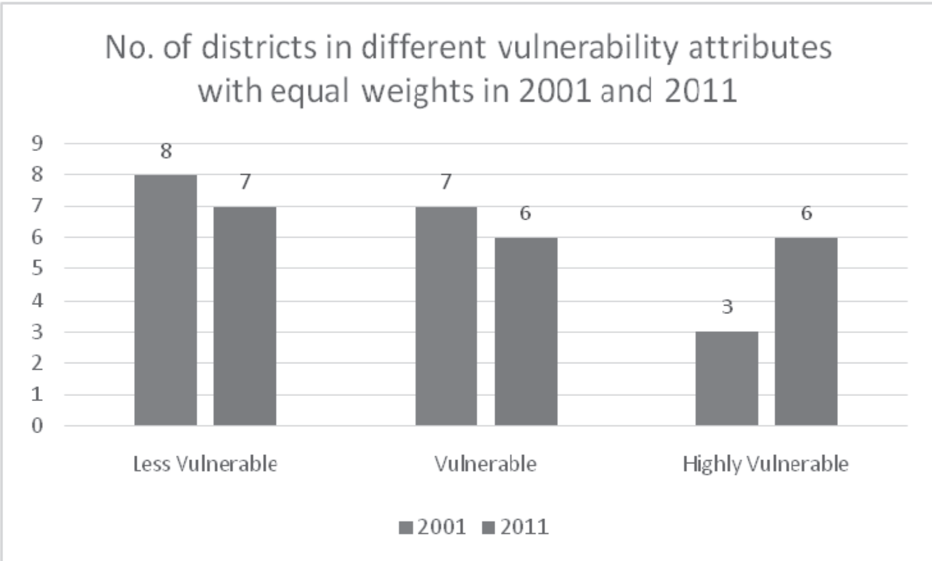


Figure 3: Number of vulnerable districts in 2001 and 2011(with equal weights)

Table 7: Distribution of vulnerable districts in 2001 and 2011 with unequal weights

Vulnerability Index	Assigned Attribute	No. of Districts	
		2001	2011
≤ 0.5629	Less Vulnerable	2 (11%)	13 (72%)
0.5629-0.6446	Vulnerable	10 (56%)	3 (17%)
≥ 0.6446	Highly Vulnerable	6 (33%)	2 (11%)

Source: author's calculation; Note: Figures in the parentheses represent percentage

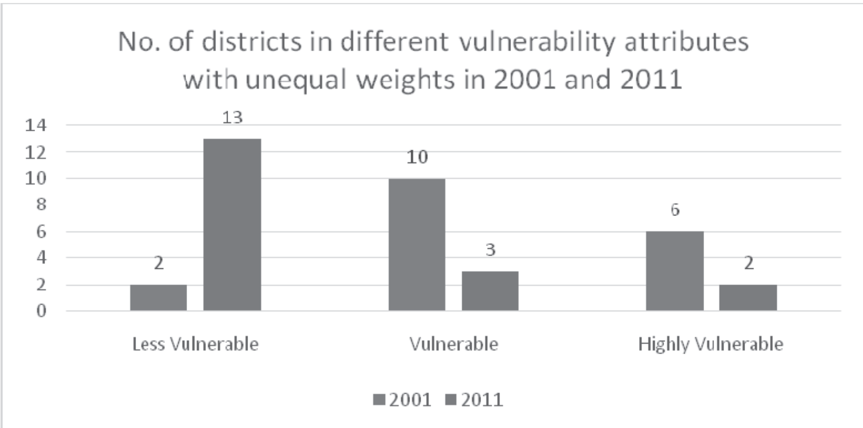


Figure 4: Number of vulnerable districts in 2001 and 2011(with unequal weights)

The lists of vulnerable districts with equal weights in 2001 and in 2011 are presented in Table 8. The highly vulnerable districts in 2001 with equal weights are West Midnapur, Purulia and South 24 Parganas while in 2011 the districts like Darjeeling, Howrah, Jalpaiguri, Purulia and Bankura are identified as highly vulnerable districts. In the case of unequal weight there are three other districts are added like East Midnapur, North 24 Parganas and Jalpaiguri to the list of highly vulnerable district compared to equal weight in 2001. In 2011 with unequal weight the highly vulnerable districts are Bankura and Purulia. It is also observed from Table 8 that the less vulnerable districts with equal weight in 2001 are Nadia, Darjeeling, Burdwan, Howrah, Murshidabad, Birbhum, Hooghly and South Dinajpur while in 2011 the less vulnerable districts are East Midnapur, West Midnapur, Hooghly, Burdwan, Murshidabad, South 24 Parganas and Murshidabad. In case of unequal weight the less vulnerable districts in 2001 are Nadia and Murshidabad while in 2011 the less vulnerable districts are East Midnapur, West

Midnapur, Hooghly, Burdwan, Murshidabad, South 24 Parganas, Cochbehar, Nadia, South Dinajpur, North 24 Parganas, North Dinajpur, Malda and Birbhum. The lists of vulnerable districts with equal and unequal weights in 2001 and 2011 have changed (Table 8).

Table 8: List of the vulnerable district in 2001 and 2011 according to their assigned attributes

Assigned Attribute	Equal Weight		Unequal Weight	
	Identified District on 2001	Identified District on 2011	Identified District on 2001	Identified District on 2011
Less Vulnerable	Nadia, Darjeeling, Burdwan, Howrah, Murshidabad, Birbhum, Hooghly, South Dinajpur	East Midnapur, West Midnapur, Hooghly, Burdwan, Murshidabad, South 24 Parganas, Murshidabad	Nadia, Murshidabad	East Midnapur, West Midnapur, Hooghly, Burdwan, Murshidabad, South 24 Parganas, Cochbehar, Nadia, South Dinajpur, North 24 Parganas, North Dinajpur, Malda, Birbhum
Vulnerable	Bankura, Coochbehar, East Midnapur, Malda, North 24 Parganas, North Dinajpur, Jalpaiguri	Nadia, South Dinajpur, North 24 Parganas, North Dinajpur, Malda, Birbhum	Birbhum, Darjeeling, South Dinajpur, Howrah, Hooghly, Burdwan, Coochbehar, Bankura, Malda, North Dinajpur	Darjeeling, Howrah, Jalpaiguri
Highly Vulnerable	West Midnapur, Purulia, South 24 Parganas	Darjeeling, Howrah, Jalpaiguri, Bankura, Purulia	East Midnapur, North 24 Parganas, West Midnapur, Purulia, Jalpaiguri, South 24 Parganas	Bankura, Purulia

Source: author's calculation

III.3 Results on determinants of vulnerability by Panel Regression

We have taken 17 independent variables as described in the sub section 2.3. The dependent variable is vulnerability indices across the districts. In order to estimate the determinants of vulnerability we apply panel regression model. We have checked the appropriateness of fixed effect model by Hausman test. The result of such test is presented in Table 9. This result shows that that the null hypothesis of random effect is rejected because the calculated value of Chi-square is greater than the critical values at 1% level of significance. Thus, the fixed effect model is used.

Table 9: Result of Hausman Test

Test Summary	Chi-square statistics	Chi-square d.f	Probability
Cross-section Random	53.163295	17	0.000

Critical values Chi-square distribution at 1% level of significance is 33.40

The result of fixed effect model is presented in Table 10. It is revealed from this Table that the maximum temperature is positive and significantly related to the vulnerability. This means that the maximum temperature has an impact on vulnerability. It is also observed that the coefficients of cropping intensity and the main agricultural population are positive and significant. This shows that the cropping intensity and agricultural population are positively contributing to vulnerability. The coefficient of net sown area is positive and significant. It is also evident from Table 10 that the coefficient of poverty is positive and significant. This reflects that poverty has an impact on vulnerability. That is, as poverty increases the vulnerability also increases and vice versa.

Table 10: Estimation results of fixed effect model

Variables	Coefficient	t-statistics	Probability
Constant	0.141401	4.066418	0.0735
Maximum temperature	0.096775	11.05103	0.05
Minimum temperature	0.044977	3.72376	0.167
Khariff season rainfall	0.012852	0.934542	0.5215
Rabi season rainfall	0.013632	0.78447	0.5765
Population Density	0.042484	2.052435	0.2886
Production of total food grain	-0.010987	-0.421743	0.7459
Small Farmers	-0.04589	-1.923675	0.3052
Cropping Intensity	0.049148	6.79613	0.093
Main Agricultural Population	0.049292	7.837233	0.0808
Net Sown Area	0.160505	6.551703	0.0964
Literacy Rate	-0.014372	-0.766029	0.5839
Livestock	0.056311	2.947193	0.2082
Farm Size	0.163478	5.153422	0.122
Per capita Income	-0.016185	-0.566269	0.672
Length Of Roads	-0.030678	-1.477212	0.3788
Poverty	0.042791	5.895481	0.098
Medical Facilities	0.047285	4.975164	0.1263
Adjusted R^2 = 0.89 ; F- Statistics = 333.6			

Source: author's calculation

IV. Conclusions and policy suggestions

The measurement of vulnerability is based on three components like exposure, sensitivity and adaptive capacity of IPCC. The following conclusions have been emerged from the above studies.

First, the district of South 24 Parganas is the most vulnerable district in 2001, its ranks first followed by the district Purulia, West Midnapur, Jalpaiguri and so on. The district Nadia is least vulnerable district of West Bengal, its rank is 18th in 2001 with equal weights.

Second, in terms of exposure, the district East Midnapur ranks first followed West Midnapur, North 24 Parganas and so on. In terms of sensitivity the district of Purulia ranks first followed by the district South 24 Parganas, Darjeeing, Howrah and so on. In respect to adaptive capacity the district North Dinajpur ranks first followed by the district Malda, East Midnapur and so on in 2001 with equal weights.

Third, in 2011 with equal weights the district Purulia is most vulnerable district followed by the district Bankura, Jalpaiguri, Howrah, Darjeeling and so on. The districts like East Midnapur and West Midnapur are less vulnerable districts in 2011.

Fourth, number of more vulnerable districts has risen in 2011 compared to that of 2001 using equal weights while the opposite picture happen using unequal weights.

Fifth, the determinants of vulnerability are identified as maximum temperature, cropping intensity, main agricultural population, net sown area and poverty. The maximum temperature is positive and significantly related to the vulnerability. This means that the maximum temperature has the impact on vulnerability. It is also noted that the cropping intensity and the main agricultural population are positive and significantly related to vulnerability and the net sown area is positive and significantly associated with vulnerability. It is also evident from the analysis that poverty line is positive and significantly related to vulnerability. This reflects that poverty has an impact on vulnerability. That is as poverty increases the vulnerability also increases and vice versa. Lastly, the paper has an important policy implication for poverty reduction and climate risk reduction measures.

Acknowledgement: This study is conducted with the financial support from Indian Council of social Science Research (ICSSR), New Delhi, India.

Appendix A

Table 11: Functional relationship with vulnerability

Determinants of Vulnerability	Sub-indicators		Functional Relationship with Vulnerability
Exposure	E1	District wise Average Max temperature (in ^{o}c)	(+)
	E2	District wise Average Min temperature (in ^{o}c)	(+)
	E3	District wise Average Rabi season rainfall (in mm)	(+)
	E4	District wise Average Kharif season rainfall (in mm)	(+)
Sensitivity	S1	District wise Population Density (Persons per Sq. km.)	(+)
	S2	District wise Production under Total Food grains (Production in thousand tonnes)	(-)
	S3	District wise no. of Small farmers (in persons)	(+)
	S4	District wise Cropping intensity	(-)
	S5	District wise Main agricultural population (in person)	(+)
	S6	District wise Net Sown area (% of geographical area)	(-)
Adaptive Capacity	A1	District wise Literacy rate (% of total population)	(-)
	A2	District wise total no live stock (per sq. km)	(-)
	A3	District wise % of average farm size	(-)
	A4	District wise % of PCI (at constant price 2004-2006)	(-)
	A5	District wise Length of Roads (in Kilometer)	(-)
	A6	District wise people live below poverty line (% of total population)	(+)
	A7	District wise no of people get medical facilities (in person)	(-)

Appendix B

Table 12: Unequal weights attached with indicators

Indicator	Sub-Indicator	Weights	
		2001	2011
Exposure	Average Max Temp	0.060457516	0.067255709
	Average Min Temp	0.037692649	0.039544417
	Average Khariff Season Rainfall	0.094353998	0.077423719
	Average Rabi Season Rainfall	0.066408963	0.073700444
Sensitivity	Population Density	0.067255899	0.065949085
	Production Under Total Food Grain	0.068027586	0.080768213
	Small Farmers	0.064658931	0.089122702
	Cropping Intensity	0.052990632	0.0666786
	Main Agricultural Population	0.103830586	0.06521994
	Net Sown Area(% Of Geographical Area)	0.071766253	0.078037455
Adaptive Capacity	Literacy Rate	0.084410208	0.0774804
	Total No Of Livestock Per Sq. Km	0.058721194	0.064219328
	% Of Average Farm Size	0.057745204	0.05158494
	Per Capita Income	0.051789101	0.083642884
	Length Of Roads	0.074490932	0.05979905
	% Of People Below Poverty Line	0.103762461	0.065882523
	No. Of People Get Medical Facilities	0.086644782	0.079450206

References

- Abson DJ, Doughill AJ and Stringer LC. (2012). Using principal component analysis for informationrich socio-ecological vulnerability mapping in Southern Africa. Applied Geography, 35: 515–524.
- Acosta-Michlik, Lilibeth, Fausto Galli, Richard J.T. Klein, Sabine Campe, Kavi Kumar, Frank Eierdanz, Joseph Alcamo, Dörthe Krömker, Alexander Carius and Dennis Tänzler. (2005). How vulnerable is India to climatic stress? Measuringvulnerability to drought using the Security Diagram concept. An International Workshop, Holmen Fjord Hotel, Asker, near Oslo, 21–23 June.

- Adger, W.N, (2006). Vulnerability', Global Environmental Change 16, 268–281. http://dx.doi.org/10.1016/j.gloenvcha.2006.02.006.
- Bohle, H. G., T. E. Downing, and M. J. Watts. (1994). Climate change and social vulnerability: The sociology and geography of food insecurity. Global Environmental Change 4(1): 37–48.
- Brooks, N, W.N. Adger, P.M. Kelly (2005). "The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation," Global Environmental Change 15(2): 151-163.Cambridge University Press, Cambridge.
- Cutter, S. L., B. J. Boruff, and W. L. Shirley (2003). Social vulnerability to environmental hazards. Social Sciences Quarterly 84(2): 243–261.
- Cutter, S.L., Mitchell, J.T. & Scott, M.S., (2000). "Revealing the vulnerability of people and places: A case study of Georgetown County, South Carolina', Annals of the Association of American Geographers 90(4), 713–737. http://dx.doi. org/10.1111/0004-5608.00219.
- Das, P and Das,A. (2017). Environmental Vulnerabilities Index Formulation in Fragile Ecosystem of the Indian Sunderbans. International Journal of Science and technology, 3(1), pp. 36-58.
- Eakin, H. & Bojorquez-Tapia, L. A. (2008). Insights into the composition of household vulnerability from multicriteria decision analysis. Global Environmental Change 18(1): 112-127.
- Easter, C. (1999). Small states development: A commonwealth vulnerability index. The Round Table 351(1): 403–422.
- Fu¨ssel H-M, Klein RJT (2006). Climate change vulnerability assessments: an evolution of conceptual thinking. Climate Change 75(3):301.–329.
- Gallopín, G.C. (2006). 'Linkages between vulnerability, resilience and adaptive capacity', Global Environmental Change 16(3), 293–303.
- Hahn, M.B., Riederer, A.M. & Foster, S.O., (2009). 'The livelihood vulnerability index: A pragmatic approach to assessing risks from climate variability and change – A case study in Mozambique', Global Environmental Change 19(1), 74–88.
- Holling, C. S. (1986). The resilience of terrestrial ecosystems; local surprise and global change. Sustainable Development of the Biosphere. W. C. Clark and R. E. Munn. Cambridge, Cambridge University Press: 292-317.
- IPCC (2001a). The Scientific Basis, Contribution of the Working Group I to the Third
- IPCC (2007). Climate Change 2007: Climate Change Impacts, Adaptation, and Vulnerability.

- IPCC, Summary for Policymakers. In Climate Change (2007). The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (eds Solomon, S. et al.), Cambridge University Press, USA, 2007.
- Iyengar, N.S., & P. Sudarshan.(1982). A Method of Classifying Regions from Multivariate Data. Economic and Political Weekly, Special Article. 2048-2052.
- Kaly, U., and C. Pratt (2000). Environmental vulnerability index: Development and provisional indices and profiles for Fiji, Samoa, Tuvalu and Vanuatu. Phase II report for NZODA. SOPAC Technical Report 306.
- Kaly, U., L. Brigugilo, H. McLeod, S. Schmsall, C. Pratt, and R. Pal. (1999). Environmental vulnerability index (EVI) to summarize national environmental vulnerability profiles. SOPAC Technical Report 275.
- Kasperson, R.E., Kasperson, J.X., Turner II, B.L., Dow, K., Meyer, W.B., (1995). Critical environmental regions: concepts, distinctions, and issues. In: Kasperson, R.E., Kasperson, J.X., Turner II, B.L. (Eds.), Regions at Risk: Comparisons of Threatened Environments. United Nations University, Tokyo.
- Kelly, P. M., W. N. Adger, (2000). Theory and practice in assessing vulnerability to climate change and Facilitating adaptation , Climatic Change, 47:325–352.
- Khan A, S. Chatterjee and D.Bisai (2013). “ Block Level Assessment of Human Vulneraility in Paschim Medinipur District, W.B: Regional Mapping of Social Contours Quantitively”, Journal of Business Management & Social science Research, Vol. 2, No. 11, ISSN No. 2319-5614.
- Krishna Kumar, K., Patwardhan, S. K., Kulkarni, A., Kamala,K., Koteswara Rao, K. and Jones, R. (2011). Simulated projections for summer monsoon climate over India by a high-resolution regional climate model (PRECIS). Current Science, 101(3): 312-326.
- Kumar N S, Aggarwal P. K., Swaroopa Rani, Surabhi Jain, Rani Saxena and Nitin Chauhan (2011) Impact of climate change on crop productivity in Western Ghats, coastal and northeastern regions of India, Current Science: Special Issue, 101 (3).
- Metzger MJ, Schro¨ter D (2006). Towards a spatially explicit and quantitative vulnerability assessment of environmental change in Europe. Reg Environ Change 6:201–216.
- Piya, Luni, Keshav Lall Maharjan and Niraj Prakash Joshi. (2012).Vulnerability of rural households to climate change and extremes: Analysis of Chepang households in the Mid-Hills of Nepal. Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August.
- Rao, C.A. Rama, Raju, B.M.K, Subba Rao, A.V.M, Rao, K.V, Rao, V.U.M, Ramachandran, K, Venkateswarlu, B, Sikka, A.K, Rao, M.S, Maheswari, M and Rao, Ch.S.(2016). A

district level assessment of vulnerability of Indian agriculture to climate change. Current Science, 110(25).pp 1939-1946.

- Smith, B and Wandel , J.(2006). Adaptation, Adaptive Capacity and Vulnerability. Global Environmental Change, 16(3), pp. 282-292.
- Stern, N (2007). The Economics of Climate Change: The Stern Review, Cambridge University Press, UK, 2007.
- Wisner, B., Blaikie, P., Cannon, T. & Davis, I (2004). At risk: Natural hazards, people's vulnerability and disasters, 2nd edn., Routledge, London.

Artha Beekshan, Volume 27, No.4, March 2019

The Dynamic Links among Human Development, Environment and Economic Growth : En Route to the Path Towards Sustainability

Sovik Mukherjee*

January 2019

Abstract

The paper points to the interactive nature of the different aspects of sustainability of development and investigates the interrelations among the various facets of development or sustainability. The chapter further makes deeper analysis of the dynamic relations among human development, the natural environment and economic growth. It has been developed and estimated as simultaneous equation econometric models (mostly of Two-Stage Least Square type), the results being useful in understanding the relative roles of economic growth, human development and environmental conservations in the sustainability of the development process. The paper estimates these models at the global level using cross country data from 1990-2015 for a cross section of 110 countries.

Key Words : Entropy Law; Sustainability; Climate change; Non_Income HDI; Environmental Performance Index; Poverty ratio; Gini coefficient; Two-Stage Least Square;

JEL Classification Codes : O15, O39, O50

I. Introduction

As there exists a biophysical foundation of all the production activities, low entropy natural resources, are inevitably required in all such processes as inputs, and their use is inevitably entropic. The abiotic material resources like iron ore or bauxite or copper would be transformed into a product of more ordered structure like steel or aluminum or copper sheets with even lower entropy for serving the consumers purpose of use of the metals. However, any of the concerned metallic conversion process has used large amount of low entropy energy and other resources like, fluxing and refining of materials, etc. which would end up as high entropy chaotically dissipated materials and waste heat of much higher disorder. In the aggregate effect, the stock of low entropy matter-energy would go down and the proportion of high entropy would go up in the concerned system. The use of biotic resources in the production process can also be similarly shown to be entropic. And finally, any use of output

---

* Assistant Professor, Department of Economics. Faculty of Commerce and Management Studies. St. Xavier's University, Kolkata, India.

of the production process for consumption or capital use would involve degradation due to gradual dissipation of the basic constituent elements of the material product compound into higher disorder in their structural form in the transformed state at the end of its life cycle. Such entropic conceptualization of the 'economic processes' is at the root of all resource and energy crisis of today's world rising entropy with use of energy and material resources, thus, explains the reality of development facing significant constraints on both natural and technical processes.

There are in fact three aspects of development — economic, social and environmental regarding all of which the issue of sustainability thus arises for reasons imputable to entropy law. The scarcity of low entropy natural resources, monopolistic or oligopolistic nature of their markets, uncertainty of climate and agrarian production and supplies, often lead to the volatility of prices of primary commodities. The impact of such price volatility gets propagated through the intersectoral linkages across various product and factor markets resulting in uncertainties in prices and business prospects. These are likely to in turn adversely affect investment prospects, growth, employment and market as well as fiscal stability of a country. Macroeconomic limits to growthand economic instability in a market driven economic system thus characterizes unsustainability of the development process as emanating from the entropy law. In view of this, there exists a two-way interactive relationship between economy and ecosystem, economic activities or their growth create a pressure on the ecosystem for the flows of resources of various kinds as well as those of waste absorption. These can be translated in terms of respective appropriation of biologically productive land and water area of different types of use, expressed in equivalent cropland with global average productivity. Such a measure called ecological footprint of an economy is the demand for eco-services by an economy in the units of use of such land area. If the measure exceeds the bio-capacity of an ecosystem of provision of land area, in terms of the same unit of measure, the excess called as eco-deficit in the units of land area is the indicator of stress on the ecosystem. If the ecological stress be growing over time, there would be growing environmental risk of collapse with regards to the functioning of the ecosystem. The carbon footprint amounting to the excess of CO2 emission over and above the absorptive capacity of the global ecosystem expressed in forest land area that would be required to absorb such excess of the unabsorbed CO2, is a part of the eco-footprint and eco-deficit. The growing eco-deficit has therefore an important implication in respect of growing accumulation of carbon di-oxide along with other Greenhouse gas in the atmosphere causing global warming, and threatening climate change. The persistence of the eco-deficit also causes loss of biodiversity which reduces the resilience of the eco-system in the event of any extreme event causing an exogenous shock to it.

In the event of such loss of resilience of the state of equilibrium, the ecosystem may become unstable and lose its balance, and it may flip on to a new eco-regime with the use of may be newrenewables. It is this uncertainty regarding the characteristics of the new eco-regime which is the major factor behind the perception that such changes are going to reduce the well-being of the people of the economy. The same is true about the threat of climate change. All these together characterize unsustainability of today's economic growth process. The sustainability of economic development in such comprehensive sense would in fact amount to such characterization of the process of economic growth which does not involve any social disruption, nor involve any environmental risk of collapse of the concerned ecosystem.

The paper points to the interactive nature of the different aspects of sustainability of development and investigates the interrelations among the various facets of development or sustainability. The chapter further makes deeper analysis of the dynamic relations among human development, the natural environment and economic growth. It has been developed and estimated as simultaneous equation econometric models (mostly of Two-Stage Least Square type), at the global level using cross country data from 1990-2015 for a cross section of 110 countries.

II. Review of the Existing Models – New Growth Theory

Endogenous growth theory or the new growth theory emerged in the 1990s to explain the poor performance of many less developed countries, which have implemented policies as prescribed in the neoclassical theories. Unlike the Solow model that considers technological change as an exogenous factor, the new growth model notes that technological change has not been equal nor has it been exogenously transmitted in most developing countries (Sengupta, 2013). New growth theorists (Romer 1986; Lucas 1988; Aghion and Howitt 1992) linked the technological change to the production of knowledge. The new growth theory emphasizes that economic growth results from increasing returns to the use of knowledge rather than labour and capital. The theory argues that the higher rate of returns as expected in the Solow model is greatly eroded by lower levels of complementary investments in — human capital (education), infrastructure, or research and development (R&D). Meanwhile, knowledge is different from other economic goods because of its possibility to grow boundlessly. Knowledge or innovation can be reused at zero additional cost and such investments in knowledge can bring about a sustained growth.

Nevertheless, markets failed to produce enough knowledge because individuals cannot capture all of the gains associated with creating new knowledge by their own investments. Policy intervention is thus considered necessary to influence growth in the long term. Hence, comes the role of human development. The new growth models therefore promote the role of government and public policies in human capital formation process in knowledge driven industries (Meier 2000). The author jumps into the bandwagon of the already existing relationship between the two-way causal links between human development and growth

(Ranis et al., 2000; Ranis & Stewart, 2005; Suri et al., 2011) with the third connecting link of environmental sustainability in this context. The major contribution in this area lies in figuring out the Environmental Kuznet's Curve. Pioneering contributions stressed the importance of pure economic growth (in terms of income per capita) as a major source of environmental degradation (Grossman & Krueger, 1995; Shafik, 1994), whereas recent contributions have shown the important role played by further aspects related to globalization, health, education, etc. (Hill and Magnani, 2002; Tisdell, 2001). herein we extend the study in a panel data set-up over 110 countries, a mix of both developed and developing — not something that exists in the literature. Policy-makers will therefore, need to pay careful attention to the factors and their impacts on the aggregate growth rate.

III. The Dynamic Links : Human Development, Environmental Sustainability and Growth

III. 1. Theoretical Background

We would now like to trace the dynamic linkages in at least some limited way by analyzing the data of actual (historical) change over real time as experienced by selected set of countries and therefore estimating and testing significance of the dynamic relationship among the concerned variables of any typical country which is representative of the sample of countries selected. However, the relationship and pathways of development with reference to the interactions among the different aspects of development are quite complex since the objective of development is sustained economic growth in income without any social disruption and without disturbance in the equilibrium of the ecosystem. In the writings of Ranis and Stewart (2005) and Suri et al. (2011) have developed empirical economic models to estimate this relationship, in particular, between human development and economic growth and clearly points to the two way interactive relation.

We, however, focus here on the following connections between Economic Growth (Growth of GDP/GNP per capita), the natural environment and the sustained improvement in level of human development. Economic growth provides the critical income resources to the households which they would allocate for expenditure so as to meet the basic minimum needs of food, health service, amenities of clean water provision and sanitation, education etc. so that people can get out of poverty and develop their capabilities for having a source of better earnings actually with the accessibility to greater spectrum of opportunities of life. However, the household's spending, on particularly health and education, given their purchasing power in most of the situations would require to be supplemented substantially by public spending on these as household spending alone would be far from adequate for the purpose of development of health, skill and knowledge. The allocation ratios of public expenditure on health and education would be in fact an important determinant for human capability and capacity build up.

There exists the other important arm of linkage between human development and economic growth. As human capability develops over time, people have greater access to labour market and opportunities of diverse types with regard to occupation. Besides, with higher education and better health the higher rate of human capital formation contributes to the growth of labour productivity and thereby to the rate of growth. Apart from expanding the human capital base, the higher level of education enables workers and managers to make better or more appropriate choice of technological base, technological innovations and local adaptation to the changing environmental and social conditions through the process of their learning by doing. Both R and D activities and wider diffusion of their successful outcomes are facilitated when people with better health, higher education and greater scientific and social awareness of the socio-ecological landscape.

All these micro level positive development can contribute to higher economic growth at macro level provided there are some macro level policy initiatives, like — higher rate of investment, promotion of exports and higher inflows of foreign capital. Human development raises the potential of growth as each skilled labourer can thereby contribute towards it through higher productivity. However, the actual translation of the potential into actual change in the intended direction would depend on how many job opportunities are going to be created to translate higher human capability in higher per capita output. Higher and wider education can in fact end up with greater educated unemployment if the macro policies end up with jobless growth.

Countries like India which has undergone such demographic transition, that is, there has been growth in the share of working age group population over time which constitutes an important force to push growth ahead provided the growing workers' population can develop the required skill as per the demand pattern of the labour market. All these are necessary conditions for the realization of what is called demographic dividend of countries like India. I would like to point out again that the distributive factors and the state of poverty are again the likely to affect the process of progress of human development influencing economic growth. Higher poverty ratio or Gini coefficients are likely to adversely affect the impact of human development on economic growth, conditional upon given values of other variables like macro economic rate of investment and its openness. The basic reason behind such nature of likely results originates from the fact that poverty and economic inequality stands in the way of everyone's getting equal access to better opportunities of life including better jobs and earning higher incomes. Social inequalities are fundamentally rooted into economic disparities and the latter emanates also from social constraints causing deprivation on ground of caste, religion and ethnic identity, etc.

There exists also dynamic linkage between economic growth and environmental changes. We have already discussed in details the ecological foot print of human consumption in terms of land use per capita in normalized units of land of global average photosynthetic productivity. Among the different types of foot print it is the carbon foot print which is the most important one. It has the highest share in the total ecological foot print and is at the root of threat of climate change. Besides, the pressure on forest area due to the pressure of change in land use is of critical importance not only because of importance of supplies of forest products for human use, but also for many other eco-services provided by forests, such as, watershed, influencing microclimate, etc. Besides forests are the store house of biodiversity which are essential for conserving the resilience of ecosystems.

However, the impact of economic activity on environmental changes and those of feedback of environmental changes on economic growth or human development are only realized in the long run. The suitable time series or panel data based model are not often available today for the analysis of such economy-environment interactive dynamics. We therefore confine our dynamic linkage analysis between economic growth and environmental changes to the effects of growth of GDP per capita on growth of CO2 emissions and changes in forest area. Since the pathways of the feedback impact of linkage of environment say CO2 growth or land use change (forest area) on economic growth are much remote and intricate, we do not attempt here to empirically trace the relationship effects of environmental changes on economic growth. The same is true for the relationship between human development and environmental changes. Besides these, it may be recalled (Sengupta, 2013) that environmental performance index positively affects both human health and ecosystem's health and thereby would contribute to both human development and GNI per capita by augmenting the supply of eco-services which would facilitate economic growth by removing the resource constants, if any.

It may, however, be noted here that human intervention to conserve resources and protect the environment from degradation due to various types of bio-chemical pollution is at the core of the environmental performance of the economy. In this context, we have, some panel data on the environmental performance index (epi) only for a limited number of years and for a selection of countries' which we use up in this regard. We can then set up a model of dynamic linkages of economy-environment-human development as follows. This would be an extended version of integrating the environment – economy linkage as well in addition to economic growth – human development linkage.

Table 1 : The list of countries considered (based on availability of data across the time period concerned)_Comparison of their HDI values over a period of 25 years Country 1990 (HDI) 2015 (HDI)

Country	1990 (HDI)	2015 (HDI)
Albania	0.635	0.764
Argentina	0.705	0.827
Armenia	0.634	0.743
Australia	0.866	0.939
Austria	0.794	0.893
Bangladesh	0.386	0.579
Belgium	0.805	0.896
Belize	0.648	0.706
Benin	0.345	0.485
Botswana	0.585	0.698
Brazil	0.611	0.754
Brunei Darussalam	0.782	0.865
Bulgaria	0.7	0.794
Burundi	0.27	0.404
Cameroon	0.444	0.518
Canada	0.849	0.92
Central African Republic	0.32	0.352
Chile	0.7	0.847
China	0.499	0.738
Colombia	0.592	0.727
Congo	0.521	0.592
Congo (Democratic Republic of the)	0.356	0.435
Costa Rica	0.653	0.776
Cyprus	0.733	0.856
Côte d'Ivoire	0.389	0.474
Denmark	0.799	0.925
Dominican Republic	0.596	0.722
Ecuador	0.643	0.739
Egypt	0.547	0.691
Fiji	0.641	0.736
Finland	0.783	0.895
France	0.779	0.897
Gabon	0.62	0.697
Gambia	0.33	0.452
Ghana	0.455	0.579
Guatemala	0.478	0.64

Guinea	0.271	0.414
Guyana	0.541	0.638
Honduras	0.507	0.625
Hong Kong, China (SAR)	0.781	0.917
Iceland	0.797	0.921
India	0.428	0.624
Indonesia	0.528	0.689
Iran (Islamic Republic of)	0.572	0.774
Iraq	0.572	0.649
Ireland	0.762	0.923
Israel	0.785	0.899
Italy	0.768	0.887
Jamaica	0.651	0.73
Japan	0.814	0.903
Jordan	0.62	0.742
Kenya	0.473	0.555
Korea (Republic of)	0.731	0.901
Lao People's Democratic Republic	0.397	0.586
Lesotho	0.493	0.497
Luxembourg	0.782	0.898
Malawi	0.325	0.476
Malaysia	0.643	0.789
Mali	0.222	0.442
Malta	0.736	0.856
Mauritania	0.378	0.513
Mauritius	0.62	0.781
Mexico	0.648	0.762
Mongolia	0.579	0.735
Morocco	0.458	0.647
Mozambique	0.209	0.418
Myanmar	0.353	0.556
Namibia	0.578	0.64
Netherlands	0.83	0.924
New Zealand	0.818	0.915
Nicaragua	0.495	0.645
Niger	0.212	0.353
Norway	0.849	0.949
Pakistan	0.404	0.55
Panama	0.662	0.788

Papua New Guinea	0.36	0.516
Peru	0.613	0.74
Philippines	0.586	0.682
Portugal	0.711	0.843
Romania	0.7	0.802
Russian Federation	0.733	0.804
Rwanda	0.244	0.498
Saudi Arabia	0.698	0.847
Senegal	0.367	0.494
Sierra Leone	0.272	0.42
Singapore	0.718	0.925
South Africa	0.621	0.666
Spain	0.755	0.884
Sudan	0.331	0.49
Swaziland	0.548	0.541
Sweden	0.815	0.913
Tajikistan	0.616	0.627
Tanzania (United Republic of)	0.37	0.531
Thailand	0.574	0.74
Togo	0.404	0.487
Tonga	0.648	0.721
Trinidad and Tobago	0.67	0.78
Tunisia	0.569	0.725
Turkey	0.576	0.767
Uganda	0.309	0.493
Ukraine	0.706	0.743
United Kingdom	0.775	0.91
United States	0.86	0.92
Uruguay	0.692	0.795
Venezuela (Bolivarian Republic of)	0.634	0.767
Viet Nam	0.477	0.683
Yemen	0.405	0.482
Zambia	0.398	0.579
Zimbabwe	0.499	0.5

Source : Computed by the author from the HDI data; Note that the dataset is skewed towards developing countries and there are less developed countries. The essence of this paper lies in capturing the developing country perspective and keeping developed countries for comparison.

III.2 Empirical Model & Methodology

Much of the literature on human development has focused on what the appropriate measures of economic development are and whether or not economic growth or per capita income levels are sufficient as measures of the well-being of a population. While it is generally accepted that growth provides the means by which an economy can upgrade its human development levels, the literature questions whether growth is sufficient as a measure of development. There is no doubt that economic growth expands a country's choice set, but the issue still remains of how to assess the ultimate objective of economic development. The analysis part of this paper is undoubtedly compatible with the overall message of the endogenous growth literature. However, the majority of these models fail to capture some fundamental elements of our empirical work, i.e. the third link in the chain – environmental sustainability. Following the works by Barro and Sala-i-Martin (1992); Wallack (2003), etc., we return to the stylized neoclassical growth model, where, the rate of growth in output per worker between period *t* and (*t – 1*) for country *i* is given by :

$$g_{it} = (1 - e^{-\lambda})[\log(\hat{y}_i^*) - \log(y_{i,t-1})] + e^{-\lambda}x_i + (1 + e^{-\lambda})x_i t + \epsilon_{it}$$

where, this paper considers *xi* to represent the host of factors that can influence the growth rate, *yi* is the output per worker and *yi,t"1* is the lagged level of output per worker, » represents the speed of convergence to the steady state, and *Eit* captures the transitory fluctuations in growth rates. But we consider, the form of averaged growth rates (Suri et al., 2011) and tailor it as per the needs of our empirical framework. Time-averaged growth rates also have a similar structure and can be derived from the basic Barro-Salai growth form. Here, we only make a distinction between the developed and developing countries and presume intra-country homogeneity across developing countries and developed countries but inter-country heterogeneity across the two groups, *viz.* developed and developing. For the averaging out technique, we simply use an exponential model

$$\bar{g}_i = \hat{\alpha}_i + \hat{\beta}_i x_i + \hat{\gamma}_i \overline{\log(y)}_i$$

of the form : *ln y = a + bx.* The growth function as used in Suri et al. (2011) is used as the basic model,

where, $\overline{\log(y)}_i$ is the base year GDP/GNP per capita. Similarly, for the Human Development growth path, we use the standard form of the improvement in the HDI i.e.

$$\Delta HD_{i1} = \kappa \; x_i + \psi_i g_{i0} + \xi_i$$

after taking into account the required environmental sustainability measurement parameters (within the *x* vector) as elucidated below along with the growth parameters. Consequently, we model this as a simultaneous equation system which may be presented as follows :

Model 1. Dependent Variable : Growth in GDP per capita over the time horizon. Independent Variables : (a) the non-income HDI in the base year, (b) Improvement in nonincome HDI over time horizon, (c) GDP/GNI per capita in the base year, (d) Average Gini coefficient over time horizon, (e) Average Head Count poverty ratio over time horizon, (f) domestic investment as a share of the GDP, (g) exports as share of the GDP and (h) Average environmental performance index over the time horizon* (see **Table 2**).

Model 2. Dependent variable : *Non-income HDI over a time horizon.* Independent variables: GDP/GNI per capita in the base year, (b) growth of GDP/GNI per capita over the time horizon, (c) Non-income HDI in the base year, (d) Average Gino coefficient over the time horizon, (e) Average poverty ratio over the given time horizon, (f) Average public expenditure on health as share of GDP ratio,(g) Average public expenditure on education as a ratio of GDP and (h) Average environmental performance index over the period for which data are available* (see **Table 3**).

Model 3. Dependent variable : *Growth of CO2 per capita* Independent variables: Rate of change of non-income HDI, Growth of GNIPC, change in epi * (see **Table 4**).

Model 4. Dependent variable : *Rate of change of forest area (as a % of total land area)* Independent variables: Change in Forest area: Growth of GNIPC, rate of change of nonincome HDI, change in epi* (see **Table 5**).

Model 5. Dependent variable : *epi*

Independent variables : GNIPC and level of non-income HDI (see **Table 6**).

*This can be taken over 2006-2016 or as 2006-2012 (only for two time spans). For Non-Income HDI, this paper separates out the income and non-income component and takes the geometric mean of only the non-income part of the HDI index. Also for Improvement in Non-Income HDI or GDP/GNI Per-capita growth we estimate a simple exponential model over the given period and of the form : $ln\ y = a + bx$

3.3 Results and Discussion

Table 2 : TSLS Results_Model 1

Variables	*Coefficient*	*Standard Error*	*z value*	*P >|z| value*
D (developing)	0.846	0.027	31.3	0.00
Base_Non income HDI	0.219	0.019	11.6	0.00
D x Base_Non income HDI	0.191	0.033	5.79	0.00
Non-income HDI_ growth	1.026	0.041	25.1	0.00
D x Non-income HDI_ growth	0.994	0.061	16.5	0.00
Base_GNI per capita	2.781	0.182	15.4	0.00
D x Base_GNI per capita	1.991	0.322	6.22	0.00
GINI Coefficient (average)	-0.153	0.045	-3.4	0.00
D x GINI Coefficient (average)	-0.255	0.102	-2.5	0.00
Poverty Ratio (Average)	-0.551	0.234	-2.4	0.00
D x Poverty Ratio (Average)	-0.710	0.042	-17.8	0.00
investment as a ratio of GDP	1.621	0.461	3.52	0.00
D x investment as a ratio of GDP	0.944	0.312	3.03	0.00
exports as ratio of GDP	3.910	1.131	2.98	0.00
D x exports as ratio of GDP	4.201	1.262	3.33	0.00
Improvement in env. performance	1.261	0.297	4.24	0.00
D x Improvement in env. performance	2.988	0.983	3.05	0.00
constant	5.711	1.211	4.71	0.00

Source : As obtained by the author in Stata 12

Table 3 : TSLS Results_Model 2

Variables	*Coefficient*	*Standard Error*	*z value*	*P >|z| value*
D(developing)	0.334	0.091	3.71	0.00
Base_GNI per capita	2.221	0.994	2.24	0.02
D x Base_GNI per capita	0.991	0.322	3.07	0.00
GNI per capita growth	0.851	0.251	3.40	0.00
D x GNI per capita growth	0.653	0.041	15.9	0.00
Base_Non income HDI	0.548	0.012	45.6	0.00
D x Base_Non income HDI	0.421	0.011	38.3	0.00
GINI Coefficient (average)	-0.79	0.145	-5.45	0.00
D x GINI Coefficient (average)	-0.293	0.011	-29.3	0.00
Poverty Ratio (Average)	-0.922	0.066	-15.4	0.00
D x Poverty Ratio (Average)	-0.467	0.032	-14.6	0.00
Exp. on educ_ratio of GDP	0.354	0.090	3.93	0.00
D x Exp. on educ_ratio of GDP	0.733	0.195	3.84	0.00
Exp. on health_ratio of GDP	0.176	0.071	2.51	0.00
D x Exp. on health_ratio of GDP	0.595	0.121	4.91	0.00
Improvement in env. performance	2.998	1.024	2.93	0.00
D x Improvement in env. performance	2.071	1.046	1.98	0.04
constant	1.550	0.291	5.33	0.00

Source : As obtained by the author in Stata 12

Table 4 : TSLS Results_Model 3

Variables	*Coefficient*	*Standard Error*	*z value*	*P >|z| value*
D(developing)	0.412	0.089	4.61	0.00
Base_GNI per capita	2.922	1.220	2.39	0.00
D x Base_GNI per capita	2.651	0.912	2.91	0.00
GNI per capita growth	1.120	0.030	37.4	0.00
D x GNI per capita growth	0.999	0.221	4.52	0.00
Average environmental perf. index	-0.664	0.033	-20.1	0.00
D x Average environmental perf. index	-0.383	0.034	-12.6	0.00
Average share of renewable energy in final energy consumption	-0.902	0.046	-19.6	0.00
D x Average share of renewable energy in final energy consumption	-0.371	0.029	-12.8	0.00
constant	0.199	1.867	0.107	0.91

Source : As obtained by the author in Stata 12

Table 5 : TSLS Results_Model 4

Variables	*Coefficient*	*Standard Error*	*z value*	*P >|z| value*
D(developing)	0.344	0.020	17.2	0.00
Base_GNI per capita	-2.910	0.991	-2.94	0.00
D x Base_GNI per capita	-2.618	1.033	-2.53	0.00

GNI per capita growth	-0.159	0.054	-54.2	0.00
D x GNI per capita growth	-0.999	0.330	-9.01	0.00
Average environmental perf. index	0.814	0.081	10.17	0.00
D x Average environmental perf. index	0.399	0.019	21.0	0.00
Average share of urban population	-0.377	0.041	-9.15	0.00
D x Average share of urban population	-0.545	0.189	-2.88	0.00
constant	3.817	0.892	4.28	0.00

Source : As obtained by the author in Stata 12

Table 6 : TSLS Results_Model 5

Variables	*Coefficient*	*Standard Error*	*z value*	*P >|z| value*
D(developing)	0.553	0.089	6.21	0.00
Base_GNI per capita	2.911	1.131	2.57	0.00
D x Base_GNI per capita	0.173	0.046	3.69	0.00
GNI per capita growth	2.722	0.353	7.71	0.00
D x GNI per capita growth	0.449	0.065	6.91	0.00
constant	4.680	1.034	4.54	0.00

Source : As obtained by the author in Stata 12

The empirical results of the first model on dynamic linkage between economic growth and human development are presented in Table 2. The estimated coefficients of the Two-Stage Least Square model clearly shows that progress of non-income human development and their initial level for the time horizon of 1990 to 2015 have got significant impact on the growth of GNI per capita for both developed and developing countries. However, the initial level of GNI per capita in the base year i.e., in 1990 has no statistically significant effect on the GNI PC growth over the time horizon. While the exogenous variables of rate of investment as share of GDP and that of exports in GDP would raise the extent of growth that is estimated for the time horizon, the average level of inequality (i.e. Gini co-efficient) or poverty ratio would depress the growth achievement as expected over the same time horizon, all the concerned coefficients of equation being statistically significant.

The impact of economic growth on the improvement of non-income human development index is exactly similar to the impact of the other way round. Both the initial level of GNI per capita and extent of its growth during the planning horizon have significant positive impact on the improvement of non-income human development index over the time horizon chosen. The initial level of the non-income HDI however has no significant impact on the extent of its improvement over the time horizon. However, the policy variables of allocation of public expenditures in social sectors as share of GDP have significant impact on the progress in human development as expected. However, rise in inequality and poverty ratio would have opposite depressing impact on non-income human development of a country of both developed and developing countries of our sample.

It is thus important to note that growth of per capita national income and rise in human capability develop have positive linkage both ways. They can thus play role of complementarity in ensuring sustainability of these two aspects of development – each one reinforcing the other. The choice of policy package should thus combine the macroeconomic growth promoting strategies like higher rate of investment and development of export market with higher rate of public spending in the social sectors of health and education. Neglect of either of these kinds of policies in favour of the other for any reason of resource constraint may lead to a lopsided development and may be counter productive in the long run for bringing out sustainability of the development process.

Besides, the results of Table 2 also tell us that there is no necessary conflict between higher growth and lower inequality. The negative sign of the coefficients of Gini measure of inequality in the model with dependent variable as per capita GNI ensures that any rise in inequality, ceteris paribus, would necessarily lead to lower growth in GNI. The rise in inequality is also regressive for the progress of human development under similar ceteris paribus condition when we consider the progress in human development as the dependent variable. It is however no surprising result on the other hand that reduction in poverty would be separately both growth promoting and promoting the pace of human development. Any redistributing income or wealth policy as well as the poverty alleviating one would be helpful for the sustainability of both economic growth and human development by accelerating their respective paces.

Table 3 presents the results of TSLS model showing the dynamic linkage between the growth of per capita income and the growth of non-income human development indicator (NHDI). Before we interpret the results let us clarify that the average growth of the variable GNI per capita over the time horizon has been taken to be the semi log growth rate as fitted to the basic data of income per capita over the time span 1990-2015 for a combination of 110 countries comprising of both developed and developing countries covered separately. Similarly we have taken to be the semi log growth rate of non-income HDI score index to be the one as estimated on the basis of the basic data over the same time horizon as that of growth of income per capita for any country over the time horizon. For other variables which have been either the value of a variable in the base year for a country or its average value for the concerned time period as determined from secondary sources or calculated as geometric mean of the observed values over the individual years of the time horizon. The TSLS method has in fact used these cross section data of the average growth rates or mean of other variate values as observed over the time horizon for the various countries separately.

The Tables 2-6 show that coefficients of the TSLS regression models as finally estimated and whose results have been presented have all been significant and appear in the equations mostly with expected sign. We have used a dummy to distinguish between the estimates of coefficients for developing countries as distinct from the developed ones for the two sets of countries because of the possible basic structural differences in the behavioural pattern of the variables between the two groups of countries. Table 3 shows the coefficients of the relevant variables as estimated for developed and developing countries separately. It may be noted that the values of coefficients of per capita income growth rate to estimate the partial effects of its variation on growth rate of human development are found to be substantively higher for developing countries compared to the ones for the developed ones. Similarly, the coefficients of average growth rate of non-income HDI to indicate its partial impact of variation on the growth rate of GNI per capital are obtained to be higher for the developing countries as compared to those of the developed ones. We thus found that both economic growth and growth of non-income human development reinforce each other, and the strength of this linkage is higher for the developing countries than for the developed ones. Besides, the coefficients of the inequality or poverty ratio variables show their partial negative impact on both income growth and growth or progress rate of non-human human development indicator. However, the order of this negative impact is again higher for developing countries as compared to the developed ones.

For the actual observed values of all the independent or exogenous variables, we estimated the rate of growth of GNI per capita as well as that of non-income human development indicator for the developed and the developing countries on the decadal dates of 1990, 2000, 2010 and 2015 using the results of the TSLS model. It is important to notice that the growth rate of per capita income has been systematically higher for the developing countries when compared with the developed ones, while the order is opposite for similar comparison in the case of levels of growth rate of non-income component of human development. So far as the time trend is concerned this has fluctuated in the case of growth rate of income per capita while it has risen secularly for the growth rate of the value of non-income non-income human development indicator over time, although the gradient of rise has been higher for the developing countries than that in case of the developed one. These results for the years covered correspond to the historical experiences of economic fluctuations. From the results derived as per the model used here, we present in shows Figures 1-7 (as per the statistical predictions) the position of developed and developing countries in this regard. While none of the results as obtained for the estimated model of linkage appears to be surprising, the policy implications are nevertheless of particular significance in respect of the developing countries. Since income growth and progress of human development (particularly in health and education) have complementarity, the policies need to take a balanced approach in deciding the development strategy of the developing countries.

Figure 1. Estimated growth of GNI_PC across Developed (DEV) and Developing (DEVLP) countries

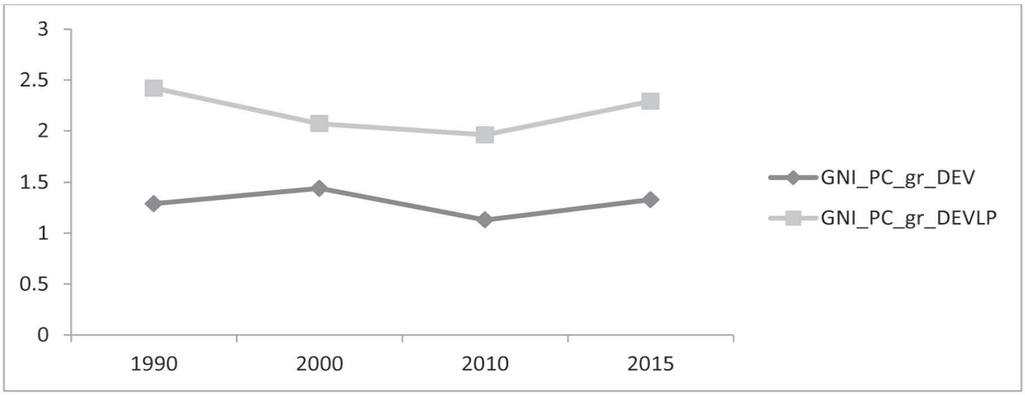


Figure 2. Estimated growth of GNI_PC across Developed (DEV) and Developing (DEVLP) countries

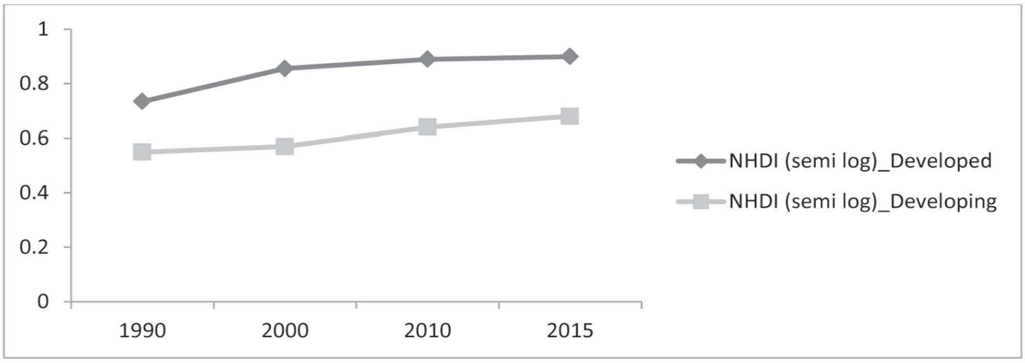


Figure 3. Estimated growth of GNI_PC across Developed (DEV) and Developing (DEVLP) countries

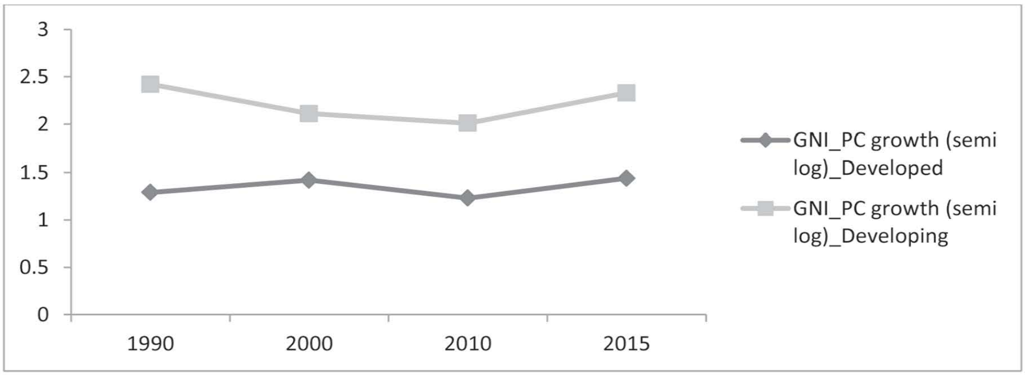


Figure 4. Estimated growth of NHDI across Developed (DEV) and Developing (DEVLP) countries

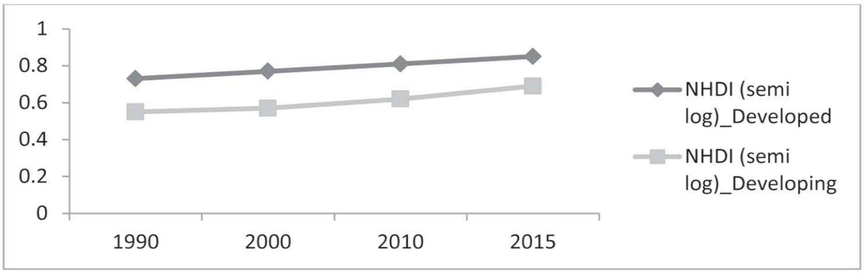


Figure 5. Estimated growth of growth CO_2 per capita across Developed (DEV) and Developing (DEVLP) countries

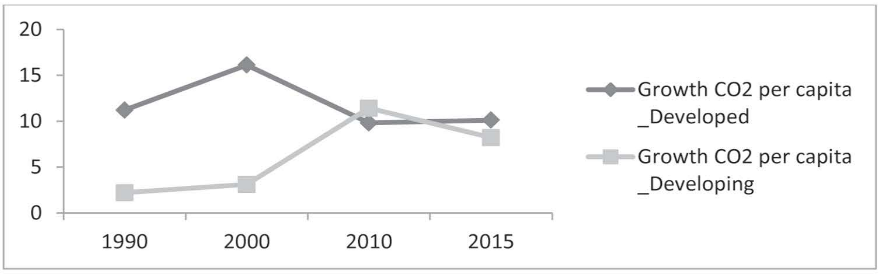


Figure 6. Estimated growth of Forest area across Developed (DEV) and Developing (DEVLP) countries

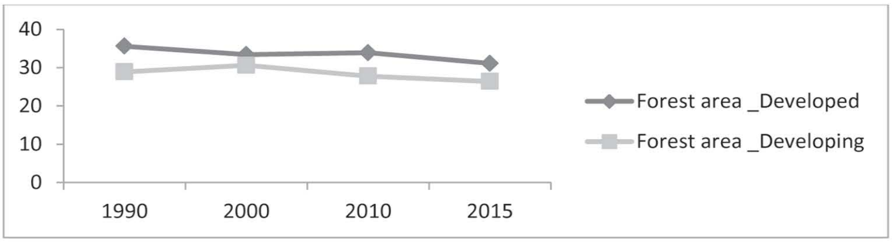
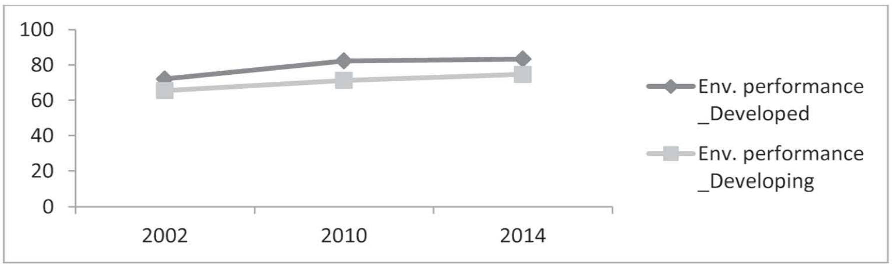


Figure 7. Estimated growth of Environmental Performance across Developed (DEV) and Developing (DEVLP) countries



Both macro level investment and trade policy on the one hand and public spending on social sectors are important for accelerating growth and translating in the form of human development in terms of determinants of capabilities. It is however difficult to infer from our data set on limited time horizon to find out which of the linkage of interdependences between human development and economic growth are more fundamental or influential. While the behaviour of the rate of growth of the non-income human development is more stable than that of the growth rate of per capita income it is well-known that the effect of human capability change on the growth of per capita income takes longer time than the growth process to impact on human development. It requires in fact panel data for a much longer time horizon to find out if high economic growth would necessarily lead to human development irrespective of policy targeting specifically for non-income human development, or if non-income human development is a more basic and fundamental factor in sustaining economic growth over time. One has to analyze the histories of the growth and the development process to arrive at more robust conclusion. We however discuss below how given our data set, the ordering of the countries changes in respect of relative growth of per capita income vis-à-vis progress of non-income human development over time.

The results of the expanded model for examining the dynamic linkages among economic growth, progress in non-income human development and the critical environmental variables of growth of CO2 emission per capita, share of forest area in total land area and environmental performance level or index are now presented in Tables 4-6. The 5-equation system incorporates 3 additional equations along with the earlier two equations – all estimated as a simultaneous equation system, for explaining together economic growth, non-income human development and environmental performance in protecting or conserving the ecosystem. The results now show that both the level of the base year GNI per capita and the growth of national income per capita have significant impact on all these three environmental outcome variables. However, neither the base year level of non-income human development, nor the average rate of progress in non-income human development has any significant impact on any of the environmental variables – growth of per capita CO2 emission, change in the share of forest area in the total land area and the variable of improvement in environmental performance. However we have found that the environmental performance index on the other than reduces the growth of CO2 emission per capita as well as raises the share of forest area and thus favourably tend to conserve the environmental resources as expected. It is also significant as a causal variable in impacting favourably on both the growth of GNI per capita as well as the progress in non-income human development. Besides, the exogenous variables of share of renewable energy in total final energy consumption and share of urban population have significant impact on CO2 emission per capita and share of forest area as expected.

IV. Conclusion

What is important for us is to notice is the interdependence of the growth, non-income human development and environmental sustainability in the light of the results observed from the 5- equation extended TSLS econometric model. The relative significances of the different linkages and the immediacy of the impact relationship are in fact of importance in prioritizing alternative policy options for ensuring sustainable development in comprehensive sense. In this context we have found the estimated growth rate or rate of change of all the five major outcome variables – growth of per capita income, annual average rate of progress of non-income HDI, rate of changes in per capita CO2 emission, share of forest area and that of environmental performance as per the results of estimates of coefficients of the TSLS models for the years 1990, 2000, 2010 and 2015 as shown.

Thus we observe that economic growth in terms of growth of per capita national income is important for both human development as well as for environmental conservation and protection. Since environmental performance index (as per its definition and construction) is policy driven exogenous variable, it is in fact most effective in impacting on environmental sustainability as expected. For environmental sustainability it is thus both growth policy and direct environmental policies relating to protecting human health and health of ecosystem would be of prime importance. The linkage or path way from human development to environmental qualitative changes being complex and remote and work out in longer time horizon it is not surprising that the model showed the impact of a significant progress in non-income human development not to be significant. Human development can have impact on environment only via its impact on the growth of income and financial capability in affording environmental policies and energy conservation as well as resource substitutions which often turn out to be costly.

References

Aghion, P., & Howitt, P. (1991). Unemployment : A symptom of stagnation or a side-effect of growth?. *European Economic Review*, *35*(2-3), 535-541.

Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy*, *100*(2), 223-251.

Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *The Quarterly Journal of Economics*, *110*(2), 353-377.

Hill, R. J., & Magnani, E. (2002). An exploration of the conceptual and empirical basis of the environmental Kuznets curve. *Australian Economic Papers*, *41*(2), 239-254.

Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3-42.

Meier, R. L. (2000). Integrating enterprise-wide risk management concepts into industrial technology curricula. *Journal of Industrial Technology*, *16*(4), 1-15.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, *94*(5), 1002-1037.

Ranis, G., & Stewart, F. (2005). *Dynamic links between the economy and human development*. UN.

Ranis, G., Stewart, F., & Ramirez, A. (2000). Economic growth and human development. *World Development*, *28*(2), 197-219.

Sengupta, R.P. (2013). *Ecological Limits and Economic Development*. Delhi, New Delhi : Oxford University Press.

Shafik, N. (1994). Economic Development and Environmental Quality : An Econometric Analysis. *Oxford Economic Papers*, *46*(Supplement_1), 757-773.

Suri, T., Boozer, M. A., Ranis, G., & Stewart, F. (2011). Paths to success : The relationship between human development and economic growth. *World Development*, *39*(4),506-522.

Tisdell, C. (2001). Globalisation and sustainability : environmental Kuznets curve and the WTO. *Ecological Economics*, *39*(2), 185-196.

Wallack, J. S. (2003). Structural breaks in Indian macroeconomic data. *Economic and Political Weekly*, *38*(41), 4312-4315.

Artha Beekshan, Volume 27, No.4, March 2019

Determinants of Gender Parity Index in Higher Education in India: A Panel Data Approach

Sanghita Ghosh*
Amit Kundu**

Abstract

According to the Times Higher Education Emerging Economies University rankings 2018, Indian Higher Education system is the second largest in the world after China. Higher Education system is the source of development and it is the key to increase the economic efficiency and social consistency. The higher education sector is a vast and varied area. Now a day there is a rapid growth of this sector and becoming more diversified. The developed nations around the world pay equal importance on participation of male and female in higher education. But in the developing countries that is not happening always. In this context Gender Parity Index (GPI) is considered as an important socio-economic indicator to measure the enrolment of women in any particular type of education in relation to men. On this ground using GPI this study analyses the factors determine the relative enrolment of male and female students in higher education. To identify the factors affect GPI in higher education, we have collected information from All India Survey on Higher Education (AISHE) published by Ministry of Human Development (MHRD) and RBI Bulletin from 2010-11 to 2015-16 for the major 17 states of India. Before starting the analysis it is assumed that the variable 'Number of colleges per lakh population' is endogenous (correlation with the error term) variable in nature. But the Hausman Specification Test reports that the assumed explanatory variable is not an endogenous variable in our investigation. Then running both Fixed Effect and Random Effect regressions it is found that Hausman Test supports Fixed Effect Model. The Fixed Effect Panel data regression shows that percentage of female teachers and male literacy rate create an important role to improve GPI in higher education in India.

Key Words : Higer Education, Gender Painty Index, Panel Data Approach

JEL Classification Codes : C22, IZI, J16.

I. Introduction

India holds an important position in the global education system. Our country has one of the largest education systems in the world and has been witnessing a healthy growth in its number

---

*M.Phil Scholar, Department of Economics, Jadavpur University, Kolkata, India
E-mail: sanghita10@gmail.com

**Professor, Department of Economics, Jadavpur University, Kolkata, India
E-Mail: akundu29@gmail.com

of institutions and enrollment. In India the regulatory framework of Higher Education is multi layered.

1. Department of Higher Education, Ministry of Human resource Development, Association of Indian Universities, Central Advisory Board of Education and State Council of Higher Education, are responsible for the overall development of Higher Education sector both in terms of Policy and Planning.

2. University Grants Commission (UGC), All India Council for Technical Education (AICTE), Medical Council of India (MCI), Bar Council of India (BCI) and State Regulators are different type of organizations which determine and maintain the standard of higher education institutions.

3. National Board of Accreditation and National Assessment of Accreditation are the two accrediting institutions.

According to All India Survey on Higher Education (AISHE) 2016-2017 report there is 864 universities, 40226 colleges and 11669 Stand Alone Institutions in India.

Higher Education system is the source of development and much of our economic and social well-being is built on this source. It is the key to increase the economic efficiency and social consistency. It helps to increase the value and efficiency of labor and thus poor can be raised from poverty. It also increases the overall productivity and intellectual flexibility of the labor force. Therefore, Higher Education System of a country helps to indicate that the country is competitive in world markets now characterized by changing technologies and production methods.

The objectives of higher education are as follows:

(1)Wisdom and knowledge: Education is both a training of minds and training of souls. So it should provide both knowledge and wisdom.

(2) Aims of the social order: Indian education system must find its guiding principle in the aims of the social order for which it prepares.

(4) Training for leadership: One of the important objectives of higher education is giving training for leadership in professional and public life. So it is the function of the higher education institutes to train the men and women for wise leadership.

Therefore, Government of India takes the following policies for improving the Higher Education sector in India.

a) Several government initiatives have been adopted to boost the growth of distance education market, besides focussing on new education techniques, such as E-learning and M-learning.

b) In recent years, education sector has seen a lot of reforms and improved financial outlays that could possibly transform the country into a knowledge heaven. Development of education infrastructure is expected to the key focus in the current decade. In this scenario it is likely to see a considerable increase in infrastructure investment in the education sector.

c) The Government of India has taken several steps for improving the higher education system in India such as opening of IIT's and IIM's in new locations as well as allocating educational grants for research scholars in most government institutions etc. Furthermore, with online modes of education being used by several educational organizations, the higher education sector in India is set for some major changes and developments in the years to come.

II. Definition of Higher Education

The higher education sector is a vast and varied area. It comprises general subject disciplines(science, humanities, arts, social and cultural sciences), technical(engineering, medicine, agricultural and life sciences and other applied sciences), education and training, vocational and skill-based programmes, training for the service and hospitality sector, teacher education, management education and so on. There is a rapid growth of this sector and becoming more diversified and today covers all types of higher education, training and research institutions. Ministry of Human Resource Development defines Higher Education as "the education, which is obtained after completing 12 years of schooling or equivalent and is of the duration of at least nine months (full time) or after completing 10 years of schooling and is of the duration of at least 3 years. The education may be of the nature of General, Vocational, Professional or Technical education".

Now a day there has been a remarkable growth of higher education system in India. However, the higher education system has many issues, like financing and management including access, equity and relevance, reorientation of programmes by laying emphasis on health consciousness, values and ethics and quality of higher education together with the assessment of institutions and their accreditation. These issues are important for the country, as it is now engaged in the use of higher education as a powerful tool to build a knowledge-based information society of the 21st Century.

In that scenario Gender Parity Index (GPI) is considered an important index to measure the progress towards gender equity and the level of learning opportunities available for women in relation to those available to men. Narrow gender gaps in educational attainment not only help to boost female participation in the workforce but also are strongly correlated with the status of girls and women in the family, linked with lower prevalence of child marriage, violent abuse by an intimate partner and improved maternal and reproductive health. Women who have parity in education are more likely to share unpaid work with men more equitably, to work in professional and technical occupations and to assume leadership roles. It serves also as a significant indicator of the empowerment of women in society.

Definition of GPI

GPI is a socioeconomic index. It is used to measure the relative enrolment in education of males and females. It is calculated as the quotient of the number of females by the number of males enrolled in a certain stage of education (primary, secondary, etc.).The main aim of GPI is to achieve equal participation of males and females in education. If the value of GPI is 1 then it indicates parity between females and males. If GPI is less than 1 then it can be said that there is a disparity in favour of boys and if the value is greater than 1 then disparity in favour of girls.

Importance of GPI in Higher Education:

The All India Survey on Higher Education (AISHE) has shown that India has now registered its best performance on the Gender Parity Index (GPI) in the last seven years- from 0.86 in 2010-11 to 0.94 in 2016-17. Specially, in Goa, Himachal Pradesh, Meghalaya, J&K, Nagaland, Sikkim and Kerala; more women are educated than men. In fact, in 2015, India was predicted to be the only country in South and West Asia to have an equal ratio of girls to boys in both primary and secondary education. However, the proportion of students pursuing higher education is in the range of 23% to 25 % since 2013-14, with not much difference.

It is assumed that equal access to education makes possible social and economic mobility of the poor. According to Schultz (2002), both for developing and more economically advanced countries, economic gains from educating girls are higher than from educating boys. Mamen and Paxson (2000) conclude that female education, like male education promotes economic growth by expanding skilled working-age population and by improving the productivity of the female labour force. A balanced distribution of education among men and women is also likely to foster economic growth if male and female human capital are production factors with diminishing returns and are imperfectly substitutable (Knowles, Lorgelly, and P. Owen, 2002). Moreover, if women get a chance to opt for higher education then it will help to produce additional social gains by reducing fertility and infant mortality, increasing life-expectancy, and increasing the quantity and quality of investments in children education (Schultz, 1988). There are many empirical studies confirm that increase in female education boosts their wages and that returns to education for women are frequently larger than that of men. It is also found that increase in women's education improve human development outcomes such as child survival, health and schooling (World Bank, 2001; Schultz, 2002; Strauss and Thomas, 1993; King and Hill, 1993). Klasen (2002) finds that lower female education has a negative effect on economic growth. Knowles et al. (2002) report that if females are educated in developing countries then it will help to reduce fertility, infant mortality and increase children's' education. Ahmad et al. (2005) study the relationship between inequality in the access to secondary education and poverty in Bangladesh.

III. Literature Review

Observing the country's gender statistics, we get a good overall indication of what has been happening in India since the Millennium Development Goals were set, and understand how close they are to achieve the various gender specific goals set by the United Nations and the Government of India. Khalid (2008) has mentioned that women are crucial to a country's development and the economic survival of their own personal households. Therefore, education is the most important tool for enhancing women's socio economic situation and statistically has been associated with better health, lower fertility rate, higher economic growth and better standards of living (Khan, 1993, Khalid, 2008). It is observed that especially in India, institutional, social, psychological and cultural boundaries limit a female's potential (Jain, 2003, Khalid, 2008). Little research has been done in India relating to the transition rates for females at further levels of education, i.e. secondary school onward. So in this chapter we will examine some of the existing research studies surrounding gender and higher education in India.

Parsons (2009) shows in the developed world, girls are more likely to go into university than boys but according to Marshall (2014) in the developing world many girls will not be able to reach secondary school. In the developing world there can be many different forms of gender inequality. In the Global South, girls access of education often get restricted as a result of deep-rooted social and cultural practices, such as preference for a son's education, violence against girls' inside the home and in educational institutions, and household duties and domestic obligations (Marshall, 2014). In India, all of the above mentioned obstructions exist, as well as a number of smaller scale issues that arise, like lack of girls' toilets or lack of female teachers. The variety of obstacles that girls' face in accessing education are also present even in the lower levels of education also. Hence, inclusive approach is required to improve the situation in India. Jain (2003) reports that the inclusion of girls in as many diverse fields as are available in society must be reinforced and the need for necessary investments in their education must be recognised. If this happened, it would change the overall situation in women's employment and consequently motivate parents and communities to support female education. Strauss and Thomas (1995), Khalid (2008) report that improving females' education will help to eliminate the gender gap in employment and earnings and this will have some important non-market benefits like improved child nutrition and lower fertility etc. Summers (1994) also concludes that females' education can impact the next generation of both sexes and probably even further.

Tilak and Biswal (2015) have pointed out that supply-side expansion and falling poverty rates have led to an increase in the demand for higher education across India. Unterhalter *et al*. (2014) have considered that improved female education can contribute to gender equality as a whole through the emergence of a new generation of educated females who are able to participate in political, social, cultural, economic and technological spheres, changed gender norms, attitudes and identities in both sexes, and changed gender relations in a variety of institutions at all levels. The GER, GPI, GAR and pass rates are all important as they influence transition rates (Tilak and Biswal, 2015, UNICEF, 2014). Chanana (2007) has said that the increased participation of girls in education would eliminate the gender gap and inequality if underachievement and under-representation were taken care of. However, this has proven to be false because it is observed that sometimes there are more girls than boys in lower levels of education and yet there is still a huge gap in secondary and further education. Parents have little or no interest in girl's education. Especially illiterate parents are not interested to educate their daughters' as they view that investment in girl's education is wastage of money and resources. There is a common view that after getting employment son of the house will earn and thus support the family financially whereas parents do not see their girls working or bringing home any income once they leave home (Khan *et al*., 2011, Desai *et al*. 2010). In Pakistan there is also a common view that after marriage a woman's responsibility is to do domestic chorus, looking after her in-laws, children and husband. Parents' think that marriage of their daughters is their primary responsibility as compared to educate their daughters. Therefore, early marriage practice in Pakistan seriously stops girl's education and it needs to stop immediately with systematic approach from government and society (Maqsood *et al*., 2012). There are several reasons behind the low enrolment in higher education; such as the high dropout rates at primary and secondary level, (Shah, 2005) conservative local culture and customs, poverty, sexual harassment, preference of boy's education over girls, lack of higher education institutions at local levels, and poor governance in universities etc. Maqsood *et al*. (2012) have reported that parents of a female student consider that coeducation is a major threat to the family honour. As members of conservative society, families believe that after studying in coeducation system, no one will marry their daughters' which strongly influence to their opposition of education with boys. Similarly Channa (2000) has documented the same scenario is present also in India. Therefore, various research studies documented that coeducation system limits enrolment of females in higher education, because most of the higher educational institutions have this system. Mehmood *et al.* (2018) found that parents are more sensible for their daughter's physical security and threat of sexual harassment. This fear stops them to send their daughters in universities and colleges. Similarly female's entry into higher education institutes is also obstructed by lack of higher educational institutions on appropriate distance. This long distances hamper female's higher education which has increased cost of physical and economic expenses. Conservative and out dated local cultural norms and values are also standing as an obstacle in the way of female's higher education. Feudalism and its sub forms Jagirdaari and Zamindari systems create challenges for female's higher education. In the past the feudal system are exploiting peasants and paying lowest wages which even is not sufficient for survival. Thus poverty and deprivation is prevailing which leads to low enrolment of females in higher education. According to UNESCO (2007) report, there is now more number of women in undergraduate than men. In an empirical study Morley *et al*. (2006) find that participation rates of men in higher education system continue to outstrip women in East Asia and the Pacific, South and West Asia and Sub-Saharan Africa. Women are globally under-represented in science and technology disciplines also. The study was based on interviews with students and staffs of higher education institutes from Nigeria, South Africa, Sri Lanka, Tanzania and Uganda. Parents may discourage daughters from active participation in laboratory work and therefore to science subjects because they are generally scheduled beyond the teaching and classroom activities. Since it entails staying late in the afternoon and in the evening at college/university and travelling home later and may be alone, women students are discouraged from participation in these activities (Channa, 2000). Numerous studies indicate that the children of parents with a college education are much more likely to go to college, even when family income is held constant (Haveman and Wolfe, 1995).

Various studies have found different conclusions on whether mother's education has greater, smaller or no impact on their children's education than fathers' education (Farré, Klein, and Vella, 2009). Studies like Behrman and Rosenzweig (2002) report that father's education has larger impact on children's education. On the other hand in a study by Becker, Hubbard and Murphy (2010) find that maternal education is more beneficial to children. Kingdon (2005) reports that for rural households, inequality in educational expenditure within these households is primarily the result of enrolment differentials between boys and girls. In the study by Kingdon (2005) it is also documented that within certain states gender disparities in educational expenditure are more prevalent in rural areas. Gender differences in educational outcomes are also related to community and family attitudes regarding the education of girls. These attitudes are embedded in cultural norms and are influenced by marriage and kinship patterns which may lead parents to invest more emotional and financial resources in educating sons rather than daughters. Rani (2002) has pointed out the state and public supports are playing a vital role in the higher education system. Despite the arguments put forth by the proponents of public spending in higher education several studies discard the same on the grounds that the benefits of public subsidy are skewed towards the higher income individuals, and higher private returns accrue to those who are enrolled in higher education (Dandekar, 1991; Rao, 1992; Shasrabuddhe and Srivastava, 1998; Verma, 1998; World Bank, 1995).

IV. Comparison between GPI in Higher Secondary and GPI in Higher Education

Initially through Table-1, we want to show how GPI changes from higher secondary education to higher education (in age cohort between 18 to 23) in all the major 17 states of India. Here we consider two years gap between GPI in higher secondary education and GPI in higher education. Because when a student is enrolled in higher secondary education he/she will complete it after two years. So after completing the higher secondary education the student will be enrolled in higher education. Actually through this table, we want to see whether GPI has decreased in higher education if we compare that with higher secondary education in male dominated Indian society.

Table 1: Comparison between GPI in Higher Secondary and GPI in Higher Education

	2010-11	2012-13	2011-12	2013-14	2012-13	2014-15	2013-14	2015-16
State	HIGHER SECONDARY	HIGHER EDUCATION	HIGHER SECONDARY	HIGHER EDUCATION	HIGHER SECONDARY	HIGHER EDUCATION	HIGHER SECONDARY	HIGHER EDUCATION
	GPI	GPI	GPI	GPI	GPI	GPI	GPI	GPI
Andhra Pradesh	0.9	0.777849	0.96	0.802363	0.99	0.809365	1.02	0.812273
Bihar	0.75	0.80343	0.9	0.808006	0.97	0.816464	1.04	0.799641
Chhatisgarh	0.81	0.8848	0.87	0.879907	0.915	0.912077	0.96	0.928927
Goa	1.04	1.568348	1.06	1.458701	1.06	1.217171	1.06	1.234438
Gujarat	0.84	0.802549	0.82	0.801747	0.82	0.789204	0.82	0.799513
Haryana	1	0.922369	1.03	0.901592	0.965	0.995104	0.9	1.017709
Jharkhand	0.89	0.976724	0.99	0.905089	0.995	0.927219	1	0.918647
Karnataka	1.04	0.93891	1.09	0.957508	1.14	0.972825	1.19	0.986082
Kerala	1.12	1.394709	1.18	1.359096	1.11	1.384341	1.04	1.315011
Madhya Pradesh	0.69	0.666986	0.76	0.800522	0.825	0.800431	0.89	0.848077
Maharashtra	0.83	0.825416	0.92	0.845151	0.96	0.855699	1	0.863452
Odisha	0.82	0.758529	0.67	0.823356	0.745	0.810416	0.7075	0.832001
Punjab	1	1.136812	1.07	1.16144	1.03	1.09207	0.99	1.104571
Rajasthan	0.63	0.691533	0.69	0.829376	0.715	0.815663	0.74	0.848117
Tamil Nadu	1.24	0.851833	1.28	0.885335	1.26	0.922094	1.24	0.915645
Uttar Pradesh	0.77	1.089726	0.84	1.131098	0.9	1.038262	0.96	1.028993
West Bengal	0.9	0.773307	0.99	0.790577	1.01	0.826269	1.03	0.846518

Source: Ministry of Human Resource Development, Govt. of India

From Table 1 we can observe that for the states Goa, Kerala, Punjab and Uttar Pradesh GPI in Higher Education in 2012-13 is greater than the GPI in Higher Secondary education in 2010-11. The similar result is found in 2011-12 and 2013-14, 2012-13 and 2014-15, 2013-14 and 2015-16. For all the mentioned states GPI values for all the years in both Higher secondary and Higher education are greater than 1 which indicates that relative access in higher education of females is higher than males in all the mentioned states. On the other hand if we observe Andhra Pradesh, we can see each year GPI value in Higher Secondary is increasing specially in the financial year 2013-14 it is 1.02 in Higher Secondary Education. On the other hand GPI in Higher Education is increasing but it is less than the Higher Secondary education. It is already said that GPI in Higher Secondary in 2013-14 is more than 1 but GPI in Higher Education in the year 2015-16 is 0.81, which is less than 1. This implies that a section of female students who passed the Higher Secondary Examination are not enrolled in Higher education. From the above table, it is observed that there is a significant improvement in GPI values for Madhya Pradesh in Higher Secondary Education. In the year 2010-11 GPI in Higher Secondary for the state Madhya Pradesh is 0.69 and in Higher Education it is 0.66 but from 2011-12 it is improving and in 2013-14 GPI in Higher Secondary education is 0.89 and GPI in Higher Education in 2015-16 is 0.84. Therefore it can be said that there is still some inequality in enrollment between male and female students. It is also observed that the GPI values in Higher Education are lower than GPI values in Higher Secondary Education in West Bengal. The GPI values in both the education sections are less than 0.90. Interestingly West Bengal's position in Higher Education is 13th in 2015-16. Gujarat position in Higher Education is 17th in 2015-16 and the GPI value in Higher Education is less than 0.80. Hence it can be concluded that there is a disparity in favor of males in higher education in both West Bengal and Gujarat.

IV. Comparison between GPI in Different Courses of Higher Education

Table 2A-2C describe the relative enrolment of female and male students in different courses of studies (Post Graduation, Under Graduation, Technical) in higher education sector in all the major 17 states of India. We calculate GPI in Post Graduate and Under Graduate as total female enrolment in Post Graduation (Under Graduation) divided by total male enrolment in Post Graduation (Under Graduation). Under the technical education PG Diploma, Diploma and certificate courses are considered. So GPI of Technical education is calculated as total enrolment of female students in PG Diploma, Diploma and certificate courses divided by total enrolment of male students in the same.

Table 2A: Comparison between GPI in different Courses of Studies

State	Post Graduate	Under Graduate	TECHNICAL	Post Graduate	Under Graduate	TECHNICAL
	2010-11 (GPI)			2011-12 (GPI)		
Andhra Pradesh	0.705219	0.718823	0.79285	0.733841	0.780412	1.02418
Bihar	0.517442	0.673757	0.74954	0.594781	0.680156	0.38714
Chhatisgarh	0.843296	0.697925	0.385127	1.130986	0.928141	0.634167
Goa	0.755257	1.313827	0.416105	0.617857	1.238873	0.336155
Gujarat	0.70349	0.788968	0.379199	0.852372	0.782396	0.338408
Haryana	1.114977	0.698095	0.193171	1.263145	0.892237	0.230599
Jharkhand	0.85226	0.777521	0.976077	0.879446	0.88701	0.568035
Karnataka	0.799028	0.893045	0.750958	0.868371	0.902009	0.675373
Kerala	1.497745	1.276355	1.631505	1.736936	1.411023	1.471845
Madhya Pradesh	0.810999	0.708784	0.525029	0.698867	0.65316	0.151619
Maharashtra	0.743377	0.718869	0.614198	0.746902	0.791387	0.589889
Odisha	0.618445	0.872012	0.245153	0.810156	0.935188	0.276747
Punjab	0.78599	0.582864	0.194388	1.78935	0.994551	0.230268
Rajasthan	0.837417	0.638063	0.355646	0.820075	0.681979	0.326308
Tamil Nadu	0.927339	0.943647	0.224757	1.065327	1.002927	0.298709
Uttar Pradesh	0.90487	1.008673	0.544383	0.901238	0.830909	0.818103
West Bengal	0.784083	0.747901	0.280826	1.113528	0.740831	0.326099

Source: Ministry of Human Resource Development, Govt. of India

Table 2B: Comparison between GPI in different Courses of Studies

State	Post Graduate	Under Graduate	TECHNICAL	Post Graduate	Under Graduate	TECHNICAL
	2012-13 (GPI)			2013-14 (GPI)		
Andhra Pradesh	0.744775	0.767927	0.984491	0.771569	0.80189	0.901518
Bihar	0.66173	0.711809	0.42318	0.720709	0.720054	0.489012
Chhatisgarh	0.971943	0.922634	0.593054	0.9624	0.924013	0.590394
Goa	2.086538	1.417536	0.391381	1.564252	1.332035	0.335005
Gujarat	0.877244	0.767093	0.363503	0.943756	0.767766	0.360625
Haryana	1.317505	0.832265	0.233501	1.37036	0.782618	0.274664
Jharkhand	0.965825	0.939455	0.395219	1.264969	0.851329	0.349777
Karnataka	0.899811	0.950423	0.604939	0.904988	0.963605	0.633948
Kerala	1.89337	1.406406	1.017423	1.768825	1.336375	1.127393
Madhya Pradesh	0.740368	0.655676	0.126829	0.90092	0.684692	0.664126
Maharashtra	0.758627	0.762311	0.567257	0.827042	0.786617	0.509675
Odisha	0.838204	0.837156	0.304841	1.033357	0.92202	0.311388
Punjab	1.98724	1.078586	0.272201	1.903448	1.077023	0.306183
Rajasthan	0.749425	0.628816	0.324267	1.158841	0.770719	0.182511
Tamil Nadu	1.122431	0.992985	0.264988	1.225313	1.030232	0.251926
Uttar Pradesh	1.008626	0.934118	0.813601	1.143766	0.982543	0.675579
West Bengal	1.075902	0.771118	0.297531	1.166929	0.79451	0.284149

Source: Ministry of Human Resource Development, Govt. of India

Table 2C: Comparison between GPI in different Courses of Studies

State	Post Graduate	Under Graduate	TECHNICA L	Post Graduate	Under Graduate	TECHNICA L
	2014-15 (GPI)			2015-16 (GPI)		
Andhra Pradesh	0.784341	0.828184	0.674056	0.815864	0.830802	0.702133
Bihar	0.737481	0.739011	0.420969	0.763163	0.731894	0.441126
Chhatisgarh	1.052395	0.953963	0.649637	1.080382	0.960946	0.728621
Goa	1.5	1.259766	0.152897	1.580363	1.241573	0.14703
Gujarat	0.980618	0.736758	0.411448	1.168399	0.71858	0.406375
Haryana	1.455489	0.864641	0.343599	1.509963	0.861992	0.390446
Jharkhand	1.293986	0.890771	0.269478	1.347936	0.897761	0.298922
Karnataka	0.986782	0.982573	0.598142	1.057482	0.997839	0.570343
Kerala	1.901042	1.367974	0.988586	2.066359	1.277986	0.901313
Madhya Pradesh	0.976682	0.692476	0.59786	1.068847	0.731798	0.668898
Maharashtra	0.795679	0.792709	0.555816	0.967137	0.783022	0.549971
Odisha	0.947857	0.913323	0.310248	0.975653	0.92115	0.378149
Punjab	1.671319	0.945391	0.447525	1.97857	0.917071	0.493503
Rajasthan	0.985108	0.790308	0.176343	1.048761	0.812938	0.215181
Tamil Nadu	1.338224	1.049527	0.281407	1.435644	1.020533	0.256947
Uttar Pradesh	1.195324	0.91431	0.488386	1.306865	0.904543	0.48356
West Bengal	1.182157	0.84437	0.392986	1.224413	0.877279	0.401231

Source: Ministry of Human Resource Development, Govt. of India

From Table 2A we find that for most of the states GPI in Post Graduate is increased from 2010-11 to 2011-12 but for that states Goa, Haryana, Madhya Pradesh the relative enrolment of female to male is decreased from 2010-2011. Similar scenario is observed for Under Graduate also. In case of Under Graduation GPI values for the states Goa, Madhya Pradesh and West Bengal are reduced from 2010-11 to 2011-12. If we look at the technical education we can observe that GPI value for Kerala exceeds 1 for both the years 2010-11 and 2011-12. So this implies that there is a disparity in favour of females in technical education. It is also observed from table 2A that the GPI value detoriates for the year 2011-12 for most of the states (Bihar, Madhya Pradesh, Maharashtra, Rajasthan etc.) in India in technical education. Though for all the states except Kerala the GPI value in technical education is less than 1 but for the states like Chhattisgarh, Orissa, and Punjab it is improved in 2011-12.

Table 2B shows the relative enrolment of female to male for the years 2012-13 to 2013-14 in different courses. In Post Graduate Goa, Haryana, Kerala, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal has crossed the GPI value 1 for both of the above mentioned years. Odisha and Rajasthan this is greater than 1 in 2012-13. So here also we can say that there is a disparity in Post-Graduation in favour of females. The same picture is shown in Under Graduate also for the states Goa, Kerala, Punjab though the values are slightly decreased in 2013-14. For other states GPI is less than 1 in Under Graduation. In case of Technical Education GPI value is less than 1 for all the states except Kerala. In Bihar, Punjab and Rajasthan this value is below 0.50 i.e. this states have huge disparity in technical education in favour of boys.

From Table 2C it is observed that in case of Post-Graduation almost all the states are crossed the GPI value 1 and the rest of the states are very near to achieve the GPI value 1 in 2015-16. In Under Graduation there is still disparity in favour of males in most of the states but the GPI values are above 0.70 for all the states. In technical education the picture is not much changed but still for some states (Andhra Pradesh, Karnataka) it is greater than 0.60. But in Goa, Uttar Pradesh, Jharkhand still there is a huge disparity in favour of male students in technical education.

Research Objective:

It is already observed from our collected data that some of the Indian states have achieved GPI value greater than 1 but for some states it is less than 1. So our objective is to identify the possible factors which are playing an important role to determine the value of GPI in India. In our investigation we are considering 17 major states of India.

DATA:

The data used in this empirical study has collected from All India Survey on Higher Education (AISHE) published by Ministry of Human Development (MHRD), RBI Bulletin and Census Data for the 17 major states of India. The study period is considered here from 2010-2011 to 2015-16.

There are different factors which may influence GPI in Higher Education in India. On the basis of the availability of data we consider the following factors which may possibly influence GPI in Indian higher education. Therefore, considering some of these factors the following variables are used in our study:

Table 3: Variables' Definition

No.	Variable	Definition
1.	GPI	Gender Parity Index. It is measured as the ratio of number of female students enrolled in higher education to the number of male students.
2.	PSDP	Per capita state domestic product at current prices. It is measured as the ratio of Net State Domestic Product and population of the state.
3.	PTR	Pupil Teacher Ratio. It is the ratio between number of students who attain the institution and the number of teachers in the institution.
4.	No_College	Number of colleges per lakh population.
5.	Female_Teacher	Percentage of Female Teachers out of total college teachers.
6.	Hostel_Intake	Total intake of women students in Girls' hostel.
7.	Expenditure_HE	Expenditure in Higher education as a percentage of GSDP.
8.	Lit_Male	Literacy rate of Male. It is used as proxy of father's education.
9.	Lit_Female	Literacy rate of Female. It is used as proxy of mother education.

VI. Theoretical Justification for Considering these Variables

PSDP: It is considered as a proxy of households' income. It is known to us that family income plays a very crucial role to decide whether the daughter/ son of the household will go for higher education. Many Indian families are low income earners. They think that it is beneficial for them to educate their son rather their daughter. So PSDP is an important factor which can influence GPI.

PTR (class size proxy): It is an indicator of infrastructure of a college. If a college has huge number of students but less number of teachers to teach them then it is difficult for these students to complete their higher studies. So a higher value of PTR implies that each teacher has to be responsible for a large number of students. Therefore, it can be said that higher the PTR, lower relative access of students to teachers.

No_College: This is an important influencing factor on GPI. Because increased number of colleges help to increase the learning opportunities both for female and male students to complete their higher studies. There are 597264 numbers of villages in India. In many cases Higher education Institutes (college or university) are far away from a village. Therefore, due to the huge distance it is very difficult for a female student to go to college. On the other hand parents of the female student don't want to send their daughter to the college considering their daughter's safety issue. In that case distance between college and home hinders the female student to enroll in higher education institutes.

Female_Teacher: A country like India, this is a very important factor to influence the GPI. It is already mentioned that GPI is an index to measure the level of learning opportunities available for women in relation to those available to men. Indian families are conservative. In this 21st century most of the Indian families still prefer to send their daughters in a college under a female teacher than male teacher considering their daughters' safety. So it is assumed that greater number of female teachers will encourage parents to send their daughters to the higher education institutes.

Hostel_Intake: Providing hostel accommodation is an important factor for enrollment of female students in higher education. It is observed in many cases there is only one college covering 5-6 number of villages. Therefore, to complete their higher studies this is also an important factor for those female students who stay far from the college.

Expenditure_HE: It is also a very important variable in our study. Higher Education is a help to grow a country. When a student moves from primary and secondary education to higher education this involves huge cost. To ensure greater participation in various types of economic activities from the economically deprived socio-religious communities' expenditure on higher education is required by the government to reduce the direct cost of education.

Lit_Male and Lit_Female: It is already said that these two variables are considered as a proxy of parental education. If parents are more educated then they always want to send their child in higher education. So it is always observed that for a wealthy family with highly educated parents there is a greater probability that the child of this family will go for higher education than the family where parents are never go to a college.

Before moving towards econometric exercise, the summary statistics of the considered variables are given below.

Descriptive Statistics:

Table 4: Summary Statistics

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Year: 2010-2011					
GPI	0.853	0.791	0.185	0.616	1.335
PSDP	61934.43	62250.87	34974.12	19111.17	168024.1
PTR	24.352	25	7.713	13	39
No_College	25.160	26.570	12.102	4.634	48.326
Female_Teacher	36.677	35.570	9.274	15.6215	55.7379
Hostel_Intake	120037.1	48413	170641.1	654	631613
Expenditure_HE	3.040	2.88	0.700	2.02	4.85
Lit_Male	76.947	76.1	8.141	59.7	94.2
Lit_Female	55.829	55.7	13.483	33.1	87.7
Year: 2015-2016					
GPI	0.947	0.915	0.152	0.799	1.315
PSDP	115698.8	123979	60865.16	34168	291022
PTR	25.529	23	12.135	14	54
No_College	29.304	32.152	12.960	6.641	52.841
Female_Teacher	39.654	37.573	11.314	17.448	58.251
Hostel_Intake	156278	102367	156067.9	1642	523870
Expenditure_HE	3.084	2.62	1.749	1.81	9.43
Lit_Male	83.311	82.4	5.880	73.39	96.02
Lit_Female	66.855	66.77	10.448	52.66	91.98

Table 4 describes the summary statics for the years 2010-11 and 2015-16. It is observed that the average GPI in 2011 is 0.85 but in 2016 it increases to 0.94. So we can say that there is an improvement in GPI. On the other hand the minimum value of GPI was 0.616 in 2010-11 and in 2015-16 it is 0.79. But for the maximum value of GPI we get a different picture. Although the maximum GPI values in 2010-11 and 2015-16 are above 1 but in 2015-16 the maximum GPI is slightly lower than 2010-11 (from 1.335 to 1.315). It is found that in 2010-11 in India the average number of colleges were 25 but in 2015-16 it is increased to 29. There is very little increase in average Pupil Teacher Ratio from 2010-11 to 2015-16. In 2010-11 there were 37% females teachers in the colleges but in 2015-16 this increased to 40%. The average hostel intake is also increased. Minimum hostel intake in 2010-11 was 652 students and in 2015-16 it is 1642. Both average male and female literacy rate are also increased from 200-11 to 2015-16. Surprisingly the minimum value of male literacy in 2010-11 was 59.7 in 2015-16 it is 73.39. So it can be said that approximately 13% increase in male literacy rate. The same picture is also observed for female literacy rate.

VII. Econometric Exercise:

We measure the relative enrollment of females to males in higher education by the socioeconomic index **GPI**. To identify the possible factors affect GPI in higher education in India, we have used panel data regression analysis in addition to the descriptive comparisons. The data here used is Balanced Panel Data set.

Before starting the analysis first we assume that the variable 'Number of colleges per lakh population' is endogenous (correlation with the error term) variable in nature. It is expected that there are some other factors which can affect GPI but due to unavailability of data these are accommodated in disturbance term may be correlated with this variable. Number of colleges in any particular state in any particular time period may depend on percentage of expenditure on higher education in that state in that particular time period. So we have two-equation Simultaneous Equation Model.

The regression equation is:

$$\begin{aligned} \text{GPI}_{it} = \; & \alpha_{11} + \beta_{11}\text{No\_College}_{it} + \beta_{12}\text{Female\_Prof}_{it} + \beta_{13}\text{PTR}_{it} + \beta_{14}\text{Hostel\_Intake}_{it} \\ & + \beta_{15}\text{PSDP}_{it} + \beta_{16}\text{Lit\_Male}_{it} + \beta_{17}\text{Lit\_Female}_{it} + \varepsilon_{11\,it} \end{aligned}$$

..................(1)

And the auxiliary regression equation is

$$\begin{aligned} \text{No\_College}_{it} = \; & \alpha_{21} + \beta_{21}\text{Expenditure\_HE}_{it} + \beta_{22}\text{Female\_Prof}_{it} + \beta_{23}\text{Hostel\_Intake}_{it} \\ & + \beta_{24}\text{PSDP}_{it} + \beta_{25}\text{Lit\_Male}_{it} + \beta_{26}\text{Lit\_Female}_{it} + \varepsilon_{21\,it} \end{aligned}$$

.... (2)

To check the endogeinity issue first we run the auxiliary regression equation and estimate the residual of the augmented equation using the fixed effect model. Then incorporate the estimated residual value in the Eq.(1) and estimate the GPI. Then run the Hausman Specification Test. If the parameter estimate of the estimated residual is statistically significant, then we can conclude that there is endogeneity in the Eq. (1). Otherwise we have to reject our assumption of endogeneity. The same procedures are followed for the random effect model also. This test of endogeneity essentially includes the residuals of the auxiliary equation of our model. But the test reports that the assumed explanatory variable is not an endogenous variable in our investigation.

Then using correlation matrix we find that there is a high correlation between the variables PTR and . So to check the impact of both these variables on GPI we consider PTR and in two different regression models.

Finally we run the following two Panel Regression models.

$$\mathrm{GPI}_{it} = \gamma + \delta_1 \mathrm{PTR}_{it} + \delta_2 \mathrm{PSDP}_{it} + \delta_3 \mathrm{Hostel\_Intake}_{it} + \delta_4 \mathrm{Lit\_Male}_{it} + \delta_5 \mathrm{Lit\_Female}_{it} + \delta_6 \mathrm{Female\_Prof}_{it} + \varepsilon_{it}$$

………… (3)

$$\mathrm{GPI}_{\mathrm{it}} = \alpha + \beta_1 \mathrm{No\_College}_{it} + \beta_2 \mathrm{PSDP}_{it} + \beta_3 \mathrm{Hostel\_Intake} + \beta_4 \mathrm{Lit\_Male}_{it} + \beta_5 \mathrm{Lit\_Female}_{it} + \beta_6 \mathrm{Female\_Prof}_{it} + \epsilon_{it}$$

…………..(4)

Where i=1,2,….17 and t=1,2,…6.

Here also Hausman Test is used to decide between Fixed Effect Model and Random Effect Model and it is found that Hausman Test supports Fixed Effect Model. This supports the argument that most of the policy variables which are accommodated in our model as explanatory variables are correlated with time invariant factor like efficiency of local administration in our model.

VIII. EMPERICAL RESULTS AND DISCUSSIONS

Enrollment of females in higher education is influenced by many factors. In order to evaluate which factors are playing vital role to decide the enrollment of females in higher education we adopt Fixed Effect estimation for both the equations Eq(3) and Eq(4) suggested through Hausman Test because the Hausman test yields

(6)= 0.0002 for Eq(3) and

(6)= 0.0176 for Eq(4).

Both the Chi-square values are statistically significant. Therefore, the results clearly lead us to accept that Fixed Effect Estimation is best for both of these two equations. Beside this there may be some state specific unobserved factors which may influence GPI in different states. So in that case to capture the state specific unobserved effect on GPI Fixed Effect estimation is appropriate.

Table 5: Determinants of GPI

Explanatory Variable	**Model 1**	**Model 2**
PTR	0.000 (0.002)	
No_College		-0.002 (0.005)
Female_Teacher	0.016** (0.003)	0.016** (0.003)
Hostel_Intake	9.36e-09 (2.61e-07)	5.01e-08 (2.74e-07)
Expenditure_HE	0.003 (0.010)	0.002 (0.010)
PSDP	5.84e-07 (4.02e-07)	7.70e-07 (5.38e-07)
Lit_Male	0.030 (0.019)	0.030*** (0.018)
Lit_Female	-0.017 (0.011)	-0.017 (0.010)
Intercept	-1.213 (0.825)	-1.164 (0.779)

,* indicate 5% and 10% level of significance respectively

Table 5 shows that according to our Model 1 discusses in Eq.(3), we can find that only percentage of female teachers have significant positive impact on GPI. This is may be due to the fact that parent of a female student think it is safe for his/her daughter to go to a college where more number of female teachers are present than male teachers. Or they may prefer totally girl's college for higher education of their daughter.

Model 2 discusses Eq (4). In this regression equation also Female percentage of teaches have positive significant impact on GPI. But beside this Male Literacy rate has also positive significant impact on GPI. It is already said that Male_Litreacy is considered here as a proxy of father's education. So it is evident that as more and more fathers are educated then more number of female students has enrolled in higher education. Plug (2004) also documents that father's education play an important role on his daughter's/son's higher education. This is because parental especially father's education plays a vital role to decide whether the daughter of a family get enrolled in higher education or not. If a father of a female student is higher educated then there is a high chance to send his daughter to opt for higher education.

IX. Conclusion

In an economy either developed or developing, it is known to all that higher education has a significant influence in the quality of life, awareness among the individual as well as in social transformation of the society. Therefore, all the countries in the world are promoting higher education in one hand and also trying to achieve gender parity in higher education. In 2005-06 Indian government has started to bring a separate gender budget. It is not a separate budget for women. The aim of gender budgeting is to deal with budgetary gender inequality issues. In this budget, special funds are allocated for females' education. Findings of the present study suggest that now a days more number of female students are eager to enrol in higher education system. It is observed that many states have crossed the GPI value 1 and some of the states are very close to achieve the GPI value 1 in higher education. This is may be due to the fact that increases in the number of female teachers in colleges and improvement in Male-Literacy rate. As parents of a girl child is always in a panic of their daughter's physical security, this hinders them to send their daughters in colleges. But if a college has more number of female teachers then that will mitigate their problem and this leads to increase female student enrolment in higher education.

Reference

Ahmad, A., Hossain, H., Mahabub and L., Manik (2005).Inequality in the Access to Secondary Education and Rural Poverty in Bangladesh: An Analysis of Household and School Level Data. Paper presented at the Workshop on Equity and Development in South Asia organized by the World bank in 2004, New Dehli, India.

Becker,G.S., Hubbard, W.H.J. and Murphy, K.M. (2010) The Market for College Graduates and the Worldwide Boom in Higher Education of Women. *American Economic Review*, 100(2), 229-233.

Behrman, J.R. and Rosenzweig, M.R. (2002).Does Increasing Women's Schooling Raise the Scholling of Next Generation. *American Economic Review*,92 (1), 323-334.

Channa, K..(2000). Treading the Hallowed Halls: Women in Higher Education in India.*Economic and Political Weekly*, 35 (12), 1012-22.

Channa, K.(2007). Globalisation, Higher Education and Gender. *Economic and Political Weekly*, 42(7), 590-598.

Dandekar, V.M. (1991). Reform of Higher Education. *Economic and Political Weekly*, *26* (46), 2631–2637.

Desai, Sonalde, Dubey, Amaresh, Joshi, Brijlal ,Sen, Mitali, Shariff, Abusaleh and Vanneman.Reeve, D. (2010).Human Development in India: Challenges for a Society in Transition.New York: Oxford University Press.

Farré, Lídia, Roger Klein, and Francis Vella.(2009). Does Increasing Parents Schooling Raise the Schooling of the Next Generation? Evidence Based on Conditional Second Moments. IZA discussion paper 3967, Bonn: IZA.

FauziaMaqsood, Sidra Maqsood&HammadRaza.(2012). Getting Higher Education: Is it Really Challenge forFemales in Pakistan. *Academic Research Journal* 2 (3).

Haveman, R. H., & Wolfe, B. L. (1995).The determinants of childrens attainments. *Journal of Economic Literature*, 33, 1829–1878.

Jain, S. (2003). Gender equality in education. *Community based initiatives in India.* Education for All Global Monitoring Report 2003/4.UNESCO.

Khalid, U. (2008). *Gender Bias in Education : Evidence from Rural India.* Undergraduate. University of New South Wales.

Khan, S. (1993). Chapter 6, South Asia. In: E. King and M. Hall, ed., *Women's Education in Developing Countries*, 1st ed. Published for the World Bank by John Hopkins University Press, pp.224, 226, 236-237.

Khan, G. A.,Azhar& Syed, M. and Shah, A. (2011).Causes of Primary School Dropout Among Rural Girls in Pakistan. The Sustainable Development Policy Institute.

Kingdon, Geeta G. (2005). Where has all the bias gone? Detecting gender bias in theintrahousehold allocation of educational expenditure.*Economic Developmentand Cultural Change* 53, 409-52.

King, Elizabeth, M.Hill, M. Anne. (1993). Women's education in developing countries : barriers, benefits, and policies. Baltimore, MD :The Johns Hopkins University Press. http://documents.worldbank.org/curated/en/849491468740172523/Womens-education-in-developing-countries-barriers-benefits-and-policies

Klasen, Stephan. (2002). Low Schooling for Girls, Slower Growth for All? Cross-CountryEvidence on the Effect of Gender Inequality in Education on Economic Development, The*World Bank Economic Review,*16(3), 345-373.

Knowles, Stephen, Paula K. Lorgelly, and P. Dorian Owen. (2002). Are EducationalGender Gaps a Brake on Economic Development? Some Cross-Country Empirical Evidence.*Oxford Economic Papers*, 54(1),118-149.

Mammen, K., and C. Paxson. (2000). Women's Work and Economic Development. *Journal of Economic Perspectives*, 14(4), 141-164.

Mehmood, S., Chong, L., &Hussain, M. (2018).Females Higher Education in Pakistan: An Analysis of Socio-Economic and Cultural Challenges. *Advances in Social Sciences Research Journal*, 5(6), 379-397.

Morley, L., Gunawardena, C., Kwesiga, J., Lihamba, A., Odejide, A., Shackleton, L. and Sorhaindo, A. (2006).Gender Equity in Selected Commonwealth Universities. Research Report No. 65 to the Department of International Development (DFID). London: DFID.

Parsons, R. (2009). *AS & A2 sociology complete revision and practice*. Kirkby-in-Furness: Coordination Group.

Plug, Erik. (2004). Estimating the Effect of Mother's Schooling on Children's Schooling Using a Sample of Adoptees. *AER* 94(1),358-368.

Rao, M.G. (1992). Proposals for state level budgetary reforms. *Economic and Political Weekly*, *27*(5), 211–222.

Rani, G. (2002).*Financing higher education in India in the post-reform period: Focus on access and equity*. Occasional Paper No. 31. New Delhi: National University of Educational Planning and Administration.

Schultz, T. (1988). Education Investments and Returns. In: *Handbook of Development Economics*. Ed. by H. Chenery, and T. Srinivasan. 1. North-Holland, Amsterdam, 543-630.

Schultz, T. Paul. (2002). Why governments should invest more to educate girls. *WorldDevelopment* 30(2), 207-225.

Shah, Salman.(2005). Challenges in the Education Sector in Pakistan. Woodrow Wilson International Center for Scholars.

Shasrabuddhe, M. & Srivastava, S. (1998). Development in higher education: Caravan of 50 year. In MarmarMukhopadhyay et al. (Eds), *Education: The next millennium. Report of the World Conference Paper-III* (pp. 421–425). Howrah: Institute of Education, Rural Studies and Development.

Strauss, J., & Thomas, D. (1993).Health, Nutrition, and Economic Development.*Journal of Economic Literature*, 36(2),766-817

Strauss, J., & Thomas, D. (1995). Human resources: empirical modeling of household and family decisions. In J. Behrman, & T. N. Srinivasan (Eds.), Handbook in development economics. Amsterdam: Elsevier.

Summers, L. (1994). *Investing in all the people*. Washington, D.C.: World Bank.

Tilak, J. and Biswal, K. (2015).The Transition to Higher Education in India. *The Transition from Secondary Education to Higher Education Case Studies from Asia and the Pacific*, 47-50, 53-58, 62-63.

UNESCO. (2007). *Baseline Definitions of Key Gender Related Concepts*. http://portal.unesco.org/en/ev.php

UNICEF, (2014). A Situational Study of India. Global Initiative on Out-of-School Children. New Delhi.

Unterhalter,E., North, A., Arnot, M. (2014). Girls' Education and Gender Equality Education Rigorous Literature Review. DOI: 10.13140/2.1.2509.8562.

Verma, V. (1998).Privatisation of higher education. In MarmarMukhopadhyay, MadhuParhar, Anita Priyadarshini, CRK Murthy (Eds), *Education: The next millennium* (pp. 426–431). *Report of the World Conference Paper-III*. Howrah: Institute of Education, Rural Studies and Development.

World Bank. (1995). *Priorities and strategies for education: A World Bank review*. Washington, DC: World Bank.

World Bank.(2001), Engendering development: Through gender equality in rights, resources, and voice. New York: Oxford University Press.

Artha Beekshan, Volume 27, No.4, March 2019

COMPARISON OF THE EDUCATION SYSTEM: INDIA AND PAKISTAN

Smritikana Ghosh#

Abstract

Two neighbor countries- India and Pakistan together are always at the center of interest mostly from the political perspective. Given all the differences that these two countries have among themselves, it is said that only education may solve their problems. Given that, this paper will compare these two countries with respect to education and will try to find out the difference, if any, between these two countries. From the analysis it is seen that with respect to different layers of education, these countries are vastly different from each other. With almost all respect, Pakistan is far behind India. At the same time, this is also true that growth rate of education attainment in case of primary and secondary level at least, Pakistan is going faster than India.

Keywords :Educational levels, Human capital, Participation rates

JEL Classification Codes :I21, I 31, I 38.

I. Introduction

Democracy and development go hand-in-hand if we abide by Amartya Sen's notion that development consists of the removal of various types of unfreedoms that leave people with little choice and little opportunity of exercising their reasoned agency. Public policy in a democratic polity has a responsibility to work continuously towards reducing the 'unfreedoms', or various forms of disadvantage, restrictions and oppressions that an individual or a community or a group faces. Education is a Right and, at least in its 'ideal' form, has both intrinsic and instrumental values: it serves to widen world views and knowledge, thus enabling people to assert their rights, question the injustices around them, and to build a cohesive and continuously evolving society that is truly democratic in spirit and not just in name; it widens opportunities and enhances the capacities required to use those opportunities in a manner that also helps in enhancing their livelihood, as well as other forms of securities; and, in reducing the inequalities that exist due to caste, class, religion, language and location.

As it is known that once India and Pakistan were under same constitution and after independence there are so many ups and downs in between these two countries. As it is mentioned already that education can solve almost all problems of inequality, so in this paper we will discuss a comparative analysis of education system of India and Pakistan. India using

---

Assistant Professor,Department of Economics,Scottish Church College,Kolkata 6

newly released data and a survey of existing studies. The story of India's educational achievements is one of mixed success. On the down side, India has 22 per cent of the world's population, but 46 per cent of the world's illiterates, and is home to a high proportion of the world's out-of-school children and youth. On the positive side, it has made encouraging recent progress in raising schooling participation. From Census 2001 data, 64.8% of Indian population are literate and in the same year literacy rate in Pakistan was 41% as said by UNESCO report (2018). Akbar (2009) said that this notable absence of India in Pakistan's higher institutions of learning and research ought to come as a surprise given India's dominant presence in Pakistan's historical, political, cultural and military existence.

Pakistan was carved out of a united British India. It considers India its main political foe, largely because of the continuing Kashmir issue. India remains its primary long-term foreign policy issue, the war on terror notwithstanding. Pakistan's military has fought two wars and has had many more skirmishes with India, having lost its more populous east ern half in 1971. But despite all of these, Pakistan's cultural and entertainment scene remains inundated by "Bollywood". Given all of this, it is strange that India is so under-studied and under-researched in Pakistan, it seems that it is almost absent. One would have thought that like the relationship between the United States (us) and Russia during the cold war and between the India and China since, India and Pakistan too (and in this case, neighbours) would have studied, researched, taught, understood and analysed each other. Unlike other adversaries in the world, Indians and Pakistanis know little about each other. In the case of Pakistan, this situation can be based on two probable explanations. The first relates to the nature of Pakistan's internal political situation and its intrusive security/military establishment which has its' influence on the creation and development of knowledge and wisdom in Pakistan, especially regarding anything to do with India. The second explanation is to be found in the rather dismal state of the progress of social sciences in Pakistan and in its weak institutions.

Given this information, in this paper, we will discuss the relative position of these two countries in terms of education and the broad reasons behind this gap of education, if any.

II. Literature Review

None of Pakistan's more than fifty public universities comes even close to being a university in the real sense of the word. Compared to universities in India and Iran, the quality of both teaching and research is far poorer. Since 1947 there have been nine different education policies in Pakistan, , none of which have actually taken root In a country where forty percent of the population is illiterate, the lack of education is a national handicap and a serious security issue. Frustrated by successive governments' inability to deliver the basics, many young Pakistanis are looking for solutions elsewhere. Just under half of the Pákistani population is dependent on others to explain serious matters of faith, law and governance because they cannot read for themselves. Pakistan has already admitted that it will not be able to meet its Millennium Development Goals in education by 2015 in contrast to India, Sri Lanka and Bangladesh, who are on track at present to meet their goals. Pakistan was created in the name of Islam under the outstanding leadership of Quaid-i-Azam. The Quran placed great emphasis on education. The Quaid as quoted above also highlighted its importance for the new nation. Unfortunately, despite high and repeated rhetoric, education remained the most neglected aspect of national life during the last half century. The literacy level is low, the female literacy levels are among the lowest in the world and the lowest in the Muslim countries.

On the other hand, in the post-independence era, India's leaders, particularly Abul Kalam Azad, advocated an education policy that would be liberal and humanitarian, and set the nation on the path of progress and prosperity. This path was neither a full continuation of the colonial modern nor a restoration of the feudal-traditional. Drawing on progressive ideas from India's "renaissance" and freedom struggle within the Indian "renaissance" and nationalism, this education policy was meant to unleash the potential of India's civilization by a process of intellectual decolonization. Unfortunately, in the past few decades, this unfinished agenda has been dumped by successive governments. It has been replaced by an educational policy which prioritises private profit over public good and will encourage cultural and intellectual imperialism.

Most university "teaching" amounts to a mere dictation of notes which the teacher had copied down when he was a student in the same department, examinations are tests of memory, student indiscipline is rampant, and a large number of teachers commit academic fraud without ever getting punished. In some universities the actual number of teaching days in a year adds up to less than half the officially required number. Some campuses are run by gangs of hoodlums and harbour known criminals, while others have had Rangers with machine guns on continuous patrol for years on end. Common wisdom has always been that increased funding can solve all, or at least most, of the systemic problems that bedevil higher education in Pakistan. But Pakistan offers an instructive counterexample: a many-fold increase in university funding from 2002-2008 resulted in, at best, only marginal improvements in a few parts of the higher education sector. This violation of "commonsense" points to the need for some fresh thinking.

According to Pervez (2009), currently, only 2 out of 10 students taking the higher secondary exams pass, and only one makes it to a university. The total higher spending for higher education increased from Rs 3.9 billion in 2001-2 to Rs 33.7 billion in 2006-7. Per university student, the average expenditure up from around Rs 30,000 in 2001-2 to Rs 135,000 in 2006-7. This is about \$2100 per student which, while small by western standards, is substantially larger than for corresponding levels in India even without the large increases in the last several years. The above may be summarised as follows: enrolment in higher education has increased many-fold over the last six decades; access is nevertheless limited to only a small fraction of the eligible population; provincial disparities are substantial; the number of formally qualified teachers is low; and funding for universities has increased enormously since 2002. But the real problem - higher education quality - has so far not entered the discussion in Pakistan.

Rosheen (2011) said that even in the most elite schools of Pakistan critical thinking is not actively encouraged across the board. It is reflective of hierarchical nature of society and deference to teachers is expected, if not demanded. However, Pákistán has had to deal with an unprecedented and overwhelming combination of natural disasters and terrorism that its South Asian neighbours have not had to manage on the same scale and comparisons need to be drawn cautiously. More worryingly, by the government's own estimates if Pákistán continues at the current rate of progress, the constitutional right to education will be provided in Punjab by 2041, in Sindh by 2049, in Khyber-Pákhtunkhwa by 2064 and in Balochistan in 2100. While progress is being made by civil society and NGOs it is limited and the scope for misinformation remains extensive. Ignorance gives the hardliners the control they need to hold an entire nation's thoughts hostage. Pakistanis have seen dramatic changes in the past few years in their own neighbourhoods and wider society. No more so than the silenced liberals. Salmaan Taseer was assassinated by his own bodyguard, Mumtaz Qadri; not one shot was fired at him from the other security guards who reportedly knew of his plans beforehand. The lawyers' movement, once held as an exemplar of democracy, showered Qbdri with rose petals at his trial while no lawyer was able to act for Taseer. Liberals cling onto the oft-cited fact that a religious party has never won an election in the country. In the immediate aftermath of the assassination of the ministers most, not all, of the members of the National Assembly stood in silence to pay their respects and proceeded to call for a more resolute effort by the PPP-led coalition to act against terrorism. There has been little evidence thus far of any action being taken against the 'culprits'.

Hasan and Mahmood (1997) are also saying that the quality of education is low, the teachers are under-paid, under-trained and dispirited. The students are apathetic as they see no relationship between education and higher earnings or status in the society. A few decades ago education was sought for cultural, religious and social progress. In 1960s, the pioneering work of Schultz and Becker working on the concept of investment in human capital proved that a high level of education is a necessary condition for economic growth and no country can make significant economic progress if majority of its citizens are illiterate. The rapid progress of East Asian Countries is largely attributed to their excellent system of education. Despite the exhortation of Quran and the Quaid as well as the international experience of education promoting rapid economic growth, Pakistan's planners continued to allocate insufficient resources for education, especially for primary education. Moreover, the money allocated was not effectively spent. The hostility of the feudais and the indifference of the educated elite (who educated their children in English medium schools in Pakistan and sent them abroad for higher education) are primarily responsible for the neglect of education in Pakistan.

Birdsall, Ross, and Sabot (1993) show that education investments have social as well as economic benefits, e.g. the lower infant mortality, greater acceptance of family planning, and better health of the family result from better- educated mothers and that gains in income growth alone are a poor measure of lost overall development. He argued that substantial foregone income gains for Pakistan due to low investments in schooling over the last three decades. There could be potential increase in current per capita income of 25 percent had Pakistan had Indonesia's 1960 primary school enrolment rates, and a potential increase of 16 percent had Pakistan sent as many girls as boys to primary school in 1960.

While the past literature has focused on the question of economic disparity, relatively little is known about inequalities that existed between the two regions in other spheres such as education. Earlier studies, while suggestive of disparities in the distribution of educational inputs in the two wings, do not provide a detailed account of the educational facilities and their evolution during 1947-71. In addition, none of the early researchers systematically examined the causes behind such inter-regional disparity. Recent research on the issue provides only a snap-shot of the situation, conveniently attributing the observed disparity to discrimination" by the state. However, sources of disparity may simply lie in unaccounted differences in, say, demographic and socio-economic characteristics of the population, structure of the education sector in the comparing regions and so on. Little is known about any differences in these factors that may mirror inter-regional differences in educational facilities. To the best of our knowledge, none of the past research on regional disparity or contemporary studies on education in Pakistan (e.g. Kazi 1994, Hoodbhoy 1998) has looked into these issues in detail.

Secondary education needs major reform in order to reduce large dropout ratios which plague Pakistani education. Only a third of Pakistani students enrolled at primary level make it beyond Class V while another two thirds drop out after Class VIII. It is argued that if one or more career based occupational skill programmes are offered at the upper secondary level (Class 8-10) as supplements to general education, dropouts can be reduced and productivity increased in the work environment.

Literature suggests that general education increases wages [Card and DiNardo (2002)]. The impact of a year of schooling on wages is estimated at about 10 percent and the average returns in countries with low levels of schooling range from 14 percent in the short run to 23 percent in the long run [Soto (2002)]. The productivity premium at the firm level for a trained worker has also been recently estimated from panel data in the OECD at 23 percent, with the wage premium of training being 12 percent [Konings, et al (2010)]. International data shows that nations with a large proportion of students enrolled in upper-secondary vocational programmes have significantly higher rates of school attendance and completion at the higher upper-secondary [Bishop and Mane (2005)]. It was also observed in the USA that those who devoted about one-sixth of their time in high school to occupation- specific vocational courses earned at least 12 percent extra one year after graduating and about 8 percent extra seven years later. In the USA, 90 percent of students attending a comprehensive high school take at least one occupation specific course, with many taking more than one. This 'occupational profilée' in US schools has remained stable since the 1980s. Further, the strong correlation between schooling and growth performance [UNESCO (2002)] in Argentina, Chile, Malaysia and Uruguay suggests that human capital may play a stronger role in the growth process once it reaches a threshold, and that high levels of upper secondary and tertiary attainment are important for human capital to translate into steady growth.

Low literacy is a natural outcome of the lack of responsiveness of the system to the economic needs of students, and explains to a great extent the high dropout rate after five years of schooling (Hameed, 2009). Labour force educational attainments show that nearly three-quarters possess less than ten years of education, while only about one percent of the relevant age group are enrolled in any skills or training programme. This figure compares unfavorably with both developed and developing countries, and impacts productivity. The severity of the social problem is even more alarming because of the ongoing demographic transition and the implications of a large numbers of young people in economically productive group, who are basically unemployable and at risk of alienation. The vocationalisation of upper-secondary education is discussed in the background of international studies which have analysed economic and social benefits from large enrolments in skills and training as supplements to general school education. The change in skill bias towards newer and higher (or different) technologies also points to the need for a major re-orientation of the education and training programme. It is believed that internationally benchmarked skills is not just about building the skills needed for the workplace in Pakistans future economy, it is also about present day marketable and economically relevant education for young people in the economically productive age group.

The status of women in Pakistan is sharply different from that in Western countries. Women have often been considered as the weaker and vulnerable section of Pakistani society in terms of education, health, employment and business opportunities, livelihood conditions, legislation, decision making, media and communication. However, in the past few decades much attention has been drawn towards women's problems all over the world. The equality of status of women with men has become an important and burning issue at the political and social levels. One may be concerned about gender equity as a development goal in its own right - as recognized by the Convention on the Elimination of all Forms of Discrimination against Women, which has been signed and ratified by 165 countries.1 According to UNDP's Human Development Report, the Gender Equality Measure (GEM) for South Asia shows the lowest value (0.235) among all the regions of the world. Furthermore, as per Gender Development Index (GDI), Pakistan has been rated among the poorest (0.179) South Asian countries where the average index is 0.226.

Education plays an important role in human capital formation and it has become one of the defining enterprises of the 21st century with the emergence of globalization and increasing global competition. It raises the productivity and efficiency of individuals and thus produces skilled manpower that is capable of leading the economy towards the path of sustainable economic development. The conventional theory of human capital developed by Becker (1962) and Chiswick Mincer (1974) views education and training as the major sources of human capital accumulation that, in turn, have a direct and positive effect on the individual's lifetime earnings. Gender inequality may have an adverse impact on a number of valuable development goals. First, gender inequality in education and access to resources may prevent a reduction in child mortality, fertility, and an expansion of education for the next generation. Various studies have proved these linkages. Secondly, it may be the case that gender inequality reduces economic growth. This is an issue important to the extent that economic growth improves well-being (as measured by such indicators as longevity, literacy and poverty), though not all types of growth do so to the same extent. The major objective of this study by Shariff (2007) is to analyze the impact of gender inequality in education on economic growth in Pakistan. It assesses the impact of gender inequality in education on economic growth during the period 1970-2005, using econometric analysis. It is suggested by many writers that gender inequality in education directly and significantly affects economic growth by lowering the average level of human capital. Any development strategy which neglects the need for enhancing the role of educated women, cannot lead to comprehensive socio-economic development. Gender inequality in education in Pakistan Pakistan is not free from gender disparity in education because of social, cultural, demographic and economic problems in the country. Society in Pakistan is patriarchal where women generally suffer discrimination in every field of life. There are several ways to measure gender inequality in education. Gross and net enrolment rates often reveal gender differences, especially when reported by income quartiles. Similarly, completion and dropout rates are another way to identify gender disparities in education. According to the current figures of Pakistan Economic Survey , males are better than their female counterparts in terms of literacy and enrolment rates at the primary and secondary levels. Pakistan has made insufficient progress to narrow down the gender gap in education. According to the education census 2005, there are currently 2,27,791 educational institutions in the country out of which 25 per cent are for boys and 21 per cent for girls and 53 per cent fall in the category of the co-education system. Data show that the overall participation is highest in Punjab followed by Sindh and NWFP, while it is lowest in Balochistan. Remote areas like the Northern Areas and AJK have almost attained equal participation in enrolment, while the lowest participation by girls in overall enrolment is in the FATA region. The above data show that the development level and education attainment have a very strong linkage. Gender disparity in education is strongly associated with economic growth.

Regarding the education system of India, Panikkar (2011) said that the distance traversed by the nation from the days of Abul Kalam Azad is so long that return is almost impossible. As a result, the character of Indian society has changed during the last 60 years: it is no more a postcolonial society. It is rather a neo-colony, increasingly reordering its d to satisfy the liberal-nationalist opinion, as these conditions for entry are expected to discourage fly-by-night operators from taking advantage of this open policy. These conditions are that foreign educational providers have to maintain a corpus fund of Rs 5 crore and that no part of the surplus generated in India by foreign education providers shall be invested for any other purpose other than for the growth and development of the educational institutions established by it in India. of all is about quality. It says: The third and most important condition A foreign education provider shall ensure that the course or programme of study offered and imparted by it in India is in conformity with the standards laid down by the statutory authority, as is of quality comparable, as to the curriculum, methods of imparting education and the faculty employed or engaged to impart education, to those of- campus in the country in which such institution referred by it to students enrolled in its main institution is established or incorporated. It sounds a laudable aim, as there would be no dilution of standards, in the unlikely event that Oxford or Harvard university decide to open their campuses in India.24 this clause is that all such institutions would Nevertheless, the actual operational part of remain “foreign” in character. What is most crucial for a country like India is the cultural implication flowing from the replication of curricula and syllabi developed to suit the sociocultural requirements of another society. A university is not only meant for the production and dissemination of knowledge, it is also the terrain in which the identity of a nation is constructed. The operation of multinational capital, euphemistically termed globalisation, has already eaten into the cultural identity of the people. The changes now being heralded in the education system through open door policy is likely to create conditions conducive for the cultural and intellectual hegemony of advanced capitalist countries. Conclusion The distance traversed by the nation from the days of Abul Kalam Azad is so long that return is almost impossible. As a result, the character of Indian society has changed during the last 60 years: it is no more a postcolonial society. It is rather a neo-colony, increasingly reordering its policy and developmental strategies in accordance with the interests of the global capitalist players. In this process of subordination, education is a crucial influencing factor, providing intellectual justification for its uncritical acceptance. The affluent Indian middle classes revel in this new-found condition, without any sense of guilt, under the pretext that it is the creation of global forces. In the process, alter- native systems of education, envisioned as a part of the anti-colonial struggle and conceived as an integral part of alter- native modernity, have been dumped. This is alarming but not surprising, because that is the logic of contemporary capitalism, which is resilient enough to function according to the exigencies of the situation. The new ambience of higher education, represented by the package of inter- connected and complimentary bills being considered by Parliament, is likely to create an intellectual substratum and cultural taste to compliment the elite oriented social and cultural transformation. The dalits and adivasis and those who are below the poverty line are likely to re- main outside the "revolution" the state hopes to achieve. Till the benefits of the new policy of modernisation continuing to accrue to a small stratum of rich and privileged, education will not be able to harness the country's human resources for national development. The justification for the new initiatives in education is the compelling need for excellence. In a country like India with such vast human capital at its command, the only way for achieving excellence is through equity and social justice.

Jha (2015) said that this is not an allusion to privatisation in its obvious form of private, fee-charging schooling, which, while acknowledged as the first step, is only one amongst the many taken towards commercialisation. She referred to the commercialisation where education is viewed merely as a product, determined and guided by the market, and the market alone. This trait is worrisome for any country, more so for one that claims to be 'the world's largest democracy' and aspires to the title of a 'developed' nation by 2020. Sen and other (2015) are experiencing an unprecedented crisis at all levels in the form of increased and unregulated commercialisation. This is not an allusion to privatisation in its obvious form of private, fee-charging schooling, which, while acknowledged as the first step, is only one amongst the many taken towards commercialisation. She referred to the commercialisation where education is viewed merely as a product, determined and guided by the market, and the market alone. This trait is worrisome for any country, more so for one that claims to be 'the world's largest democracy' and aspires to the title of a 'developed' nation by 2020. Democracy and development go hand-in-hand if we abide by Amartya Sen's notion that 'development consists of the removal of various types of unfreedoms that leave people with little choice and little opportunity of exercising their reasoned agency'. Education is a Right and, at least in its 'ideal' form, has both intrinsic and instrumental values: it serves to widen world views and knowledge, thus enabling people to assert their rights, question the injustices around them, and to build a cohesive and continuously evolving society that is truly democratic in spirit and not just in name; it widens opportunities and enhances the capacities required to use those opportunities in a manner that also helps in enhancing their livelihood, as well as other forms of securities; and, in reducing the inequalities that exist due to caste, class, religion, language and location. If education, in its form and delivery, is guided almost entirely by commercial concerns, it cannot fulfil this role and, therefore, the commercialisation of education is dangerous for a country desirous of attaining both economic growth and reduced inequality while, at the same time, sustaining and deepening its democracy.

The General Agreement on Trade and Tariffs (GATT) began in 1947 with a small group of major trading nations, which till the end of 1994 rose to 128 member nations. Uruguay round of negotiations (1986-1994) broadened the trade rules to include services along with trade amid considerable opposition from influential developing countries such as Brazil, India and also from some developed nations. Subsequently, World Trade Organisation (WTO) replaced GATT in January 1995. At the same time the need for a framework to negotiate about trade in services led to the formation of General Agreement on Trade in Services (GATS). The agreement, which came into force in January 1995, is the first and only set of multilateral rules covering international trade in services. The agreement applies to measures by WTO members, which affect trade in services. It is voluntary agreement entered into by a nation to provide market access to outsiders in specific sectors.

Attaining Global Outlook Higher education has become a lucrative business due to increased personal mobility, easy access to knowledge even beyond national barriers, increased demand for higher education, especially in developing countries (Singh and Jindal, 2006). With growing awareness the demand for quality higher education is rising consistently and education seekers cannot be forced to choose an institute within the country. Information revolution and the growth in online learning have resulted in the creation of global market for education. Trade in higher education services has grown at tremendous pace with markets growing globally worth $30 billion in 1999. In 1996 the US generated a $6.6 billion trade surplus in its educational and training services export sector. It earned $8.5 billion from this sector in 1997 making it fifth largest service export. Global public spending on education is equivalent of Rs 47,00,000 crore as per estimates of WTO.

GATS and Education Services under GATS are broadly classified into 12 classified sectors including education. It further contains sub sectors running into 161 service activities. Education sector covers the following sub sectors- Primary education, Secondary education, Higher education (including postsecondary technical and vocational education services), Adult education and other education (e.g. testing and certifications).

UGC feels that Indian higher education system will be able to gain global identity if college and university departments are provided with more conducive and flexible environment for development. To take up the challenge in higher education as per GATS it proposes to; Identify and fund universities and colleges, which have potential for excellence, like to pursue the concept of autonomy through a reward-based Autonomy Promotion Activity (APAC), National Assessment and Accreditation Council's (NAAC) process of assessment and accreditation of each college and university, linked to financial incentives, promote opportunities for foreign students to study in Indian colleges and universities. Universities would be encouraged to expand their activities outside India by promoting web- based education and also by initiating twin programmes in other countries. Special funds would be provided for fostering an export culture in the Universities academic character of their work on a level recognised as adequate by Universities of other countries. Universities are our national institutions, and to keep our national prestige, our degrees must be such as to command international recognition. UGC is aware that higher education cannot be developed to the exclusion of the nation's commitment to education to each and every one. It foresees a unique chance to make higher education a vehicle to strengthen the newly found identity of India in the world.

Indian education policy today also reflects an increasing preoccupation with excellence in education (Nambissan and Batra, 1989). While the Kothari Commission Report (1968) does refer to the creation of a minimum number of 'quality institutions', the major emphasis was on the equalisation of educational opportunities among different social groups. In the New Education Policy, 1986, almost twenty years later, while we do hear an echo of the need for universal schooling, considerably more pronounced is the concern voiced for 'good quality education', the need to 'sift talent' and to identify and promote 'excellence' at the school stage itself. What appears as a shadowy outline of a shift in policy can be more clearly seen in the Programme of Action and subsequent documents where details are given of Navodaya Vidyalayas-schools that are being established in rural areas with the specific objective of identifying and promoting excellence and talent.

David and Nagar (2001) explained that India's disadvantage vis-ä-vis other countries in primary school participation rates is now much smaller compared to that for youth literacy rates, since 93.4 per cent of Indian elementary school age children were enrolled in school in 2006 according to the Annual Survey of Education Report (ASER) (Pratham, 2007). However, at the secondary school level, India is again at a large disadvantage with respect to all three other BRIC countries where secondary enrolment rates are far above those predicted for countries at their levels of per-capita GDP. Brazilian and Russian secondary school net enrolment rate is 27 percent higher than that of India.

III. Objectives

From the literature survey, it is clear that there are many studies separately either on Indian or Pakistan's education system. However, there is no such comparative study on the education system of India and Pakistan. Based on that, the objectives of this paper are:

1. A comparative analysis of the rate of participation in education in both India and Pakistan.

2. At the disaggregated level, compare the education participation in both countries.
3. And finally, the comparative analysis of drop-out rates from education in those two countries.

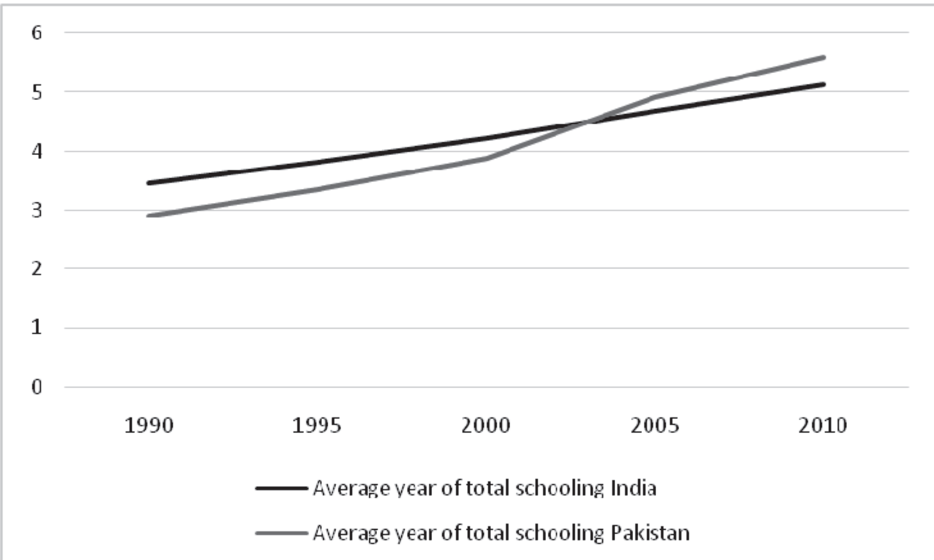
Data Base And Methdology

This paper deals with secondary data collected from different Government websites of India and Pakistan. The methodology is simply the diagrammatic representation of the data so that relative position of India and Pakistan in terms of education level can be easily comparable.

IV. Analysis

Here we will basically study the growth pattern of education system of India and Pakistan over the years. Here schooling will be divided in two three parts- primary level, secondary level and tertiary level. Primary level means below class five, secondary level means below class eleven and tertiary means more than secondary level of schooling.

Diagram 1: Average year of total schooling



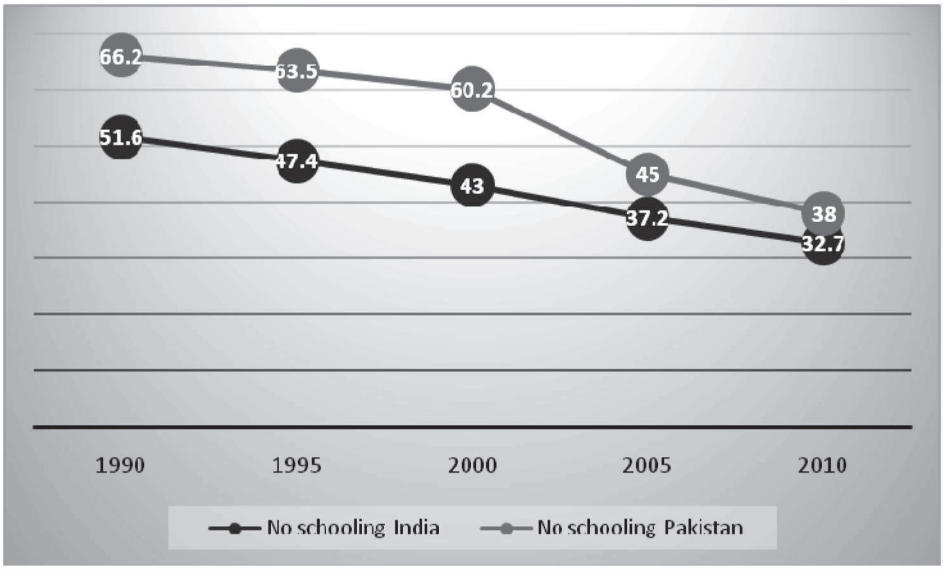
Source: Calculated by author from the data http://mhrd.gov.in/statist and https://www.epdc.org/country/pakistan

Diagram 1 shows the average year of total schooling in Pakistan and India. The diagram shows that over the year, the growth rate is more in Pakistan than that in India. Throughout the time period of our concern, the average percentage of schooling is steady increasing in India. In the year 2003-04, the average rate of Pakistan has crossed that of India and becomes higher then after. One more thing is the gap between the average rate of total schooling is increasing across the time though insignificant.

Diagram 2 is also showing that though the gap is falling, India has more no schooling population than that of Pakistan. However, both countries are facing the falling trend of no schooling population. As compared to world data, both the countries are still facing the more than average percentage of no schooling population.

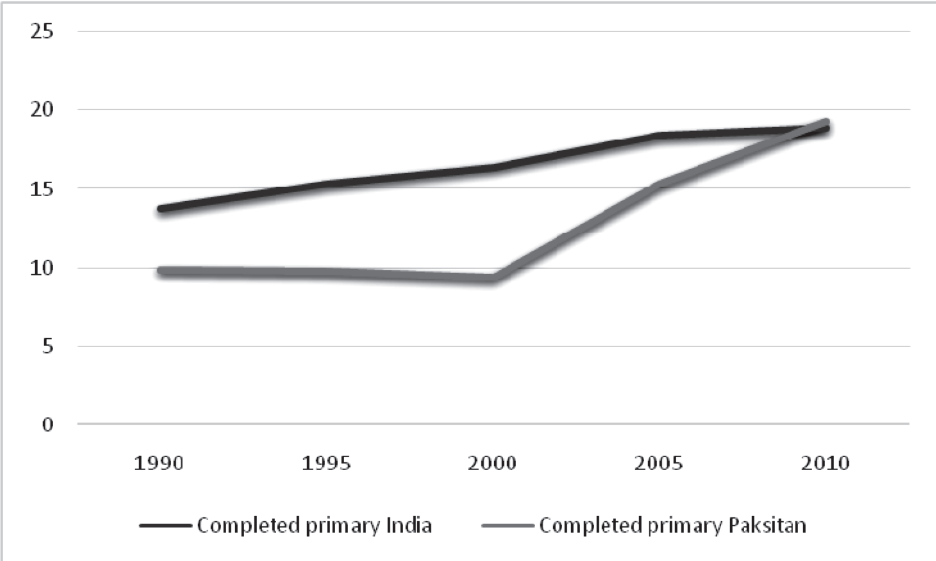
Percentage of population who completed primary level of education is more in India than that of Pakistan across the years (Diagram 3). However, the gap is falling continuously and in 2010, the gap is zero. It should be noted that since 2000, the growth rate of percentage of population completed primary education is significantly high in Pakistan than that of India.

Diagram 2: No schooling over the years for India and Pakistan



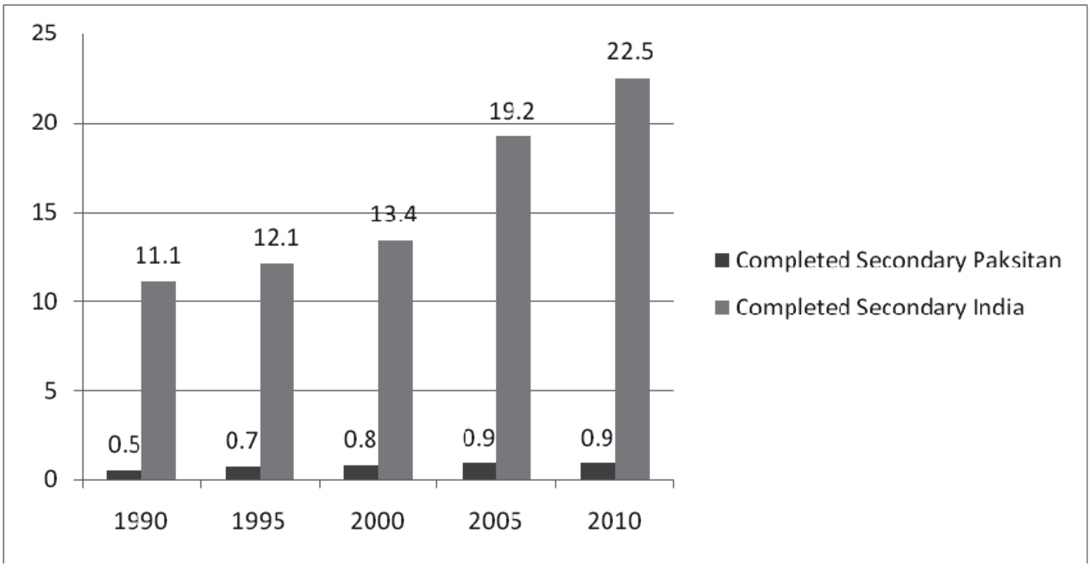
Source: Calculated by author from the data http://mhrd.gov.in/statist and https://www.epdc.org/country/pakistan

Diagram 3: Percentage of population completed primary level of education



Source: Calculated by author from the data http://mhrd.gov.in/statist and https://www.epdc.org/country/pakistan

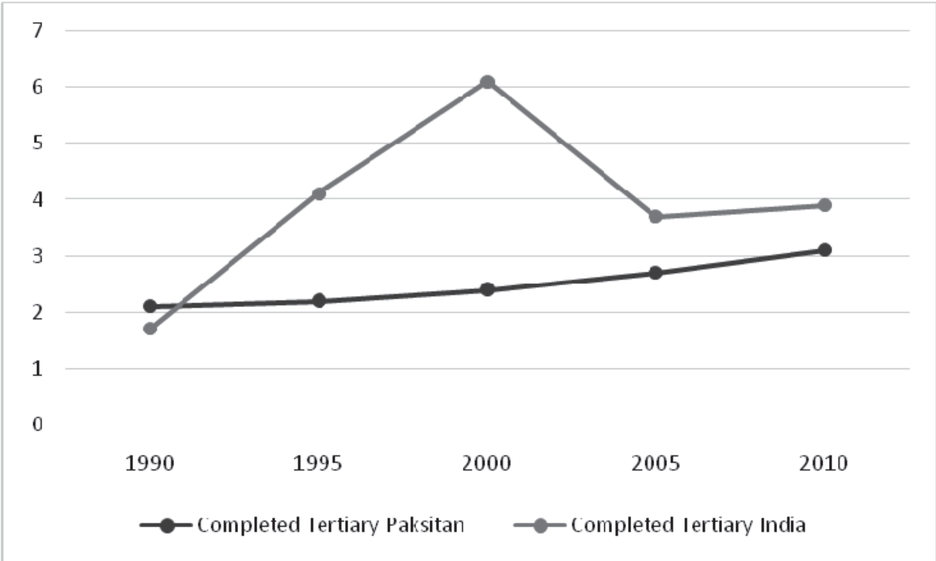
Diagram 4: Percentage of population completed secondary education



Source: Calculated by author from the data http://mhrd.gov.in/statist and https://www.epdc.org/country/pakistan

Next diagram (Diagram 4) is showing that the percentage of population completed secondary education in both countries. This percentage is always high in India than Pakistan. Not only that, the percentage is significantly increasing in India from 11.1% in 1990 to 22.5% in 2010, whereas in Pakistan it is almost stagnant and very insignificant.

Diagram 5: percentage of population completed tertiary education



Source: Calculated by author from the data http://mhrd.gov.in/statist and https://www.epdc.org/country/pakistan

Here tertiary education means the education more that higher secondary level. Diagram 5 is showing that Pakistan is facing a steady and very slow growth rate in the percentage of population completed tertiary education. Till 2000, India had a significant high growth rate of the percentage. Then after there was a steep fall till 2005 and then onwards it is increasing almost at the same rate of Pakistan. However, with all ups and downs, the percentage of population completed tertiary education is more in India than that of Pakistan.

V. Conclusion

The paper has tried to find out the difference between two neighbor countries, India and Pakistan, in terms of education attainment. To do that, secondary data is used to make several diagrammatic comparisons. Analysis found that though in terms of completion of education at different levels, Pakistan is far behind his neighbor country, but in some respect, the performance rate is higher in Pakistan than that of India. Thus one can fairly expect that in near future, Pakistan can improve its educational position will be a competitor of India.

References

Becker, Gary S. "Investment in human capital: A theoretical analysis." *Journal of political economy* 70, no. 5, Part 2 (1962): 9-49.

Birdsall, Nancy, David Ross, Richard Sabot, Hartwig de Haen, and Zeba A. Sathar. "Underinvestment in Education: How Much Growth has Pakistan Foregone?[with Comments]." *The Pakistan Development Review* 32, no. 4 (1993): 453-499.

Card, David, and John E. DiNardo. "Skill-biased technological change and rising wage inequality: Some problems and puzzles." *Journal of labor economics* 20, no. 4 (2002): 733-783.

Chaudhry, Imran Sharif. "Gender Inequality in Education and Economic Growth: Case Study of Pakistan." *Pakistan Horizon* 60, no. 4 (2007): 81-91. http://iproxy.inflibnet.ac.in:2060/stable/41500094.

Chiswick, Barry R., and Jacob Mincer. "Time-series changes in personal income inequality in the United States from 1939, with projections to 1985." *Journal of Political Economy* 80, no. 3, Part 2 (1972): S34-S66.

Faust, David, and Richa Nagar. "Politics of Development in Postcolonial India: English-Medium Education and Social Fracturing." *Economic and Political Weekly* 36, no. 30 (2001): 2878-883. http://iproxy.inflibnet.ac.in:2060/stable/4410920.

Hoodbhoy, Pervez, ed. *Education and the state: Fifty years of Pakistan*. Vol. 50. Oxford University Press, USA, 1998.

Hoodbhoy, Pervez. "Pakistan's Higher Education System—What Went Wrong and How to Fix It." *The Pakistan Development Review* 48, no. 4 (2009): 581-94. http://iproxy.inflibnet.ac.in:2060/stable/41261335.

http://www.pratham.org/file/Read-India-Report2007-08.pdf.

JHA, JYOTSNA. "EDUCATION INDIA PRIVATE LIMITED." *India International Centre Quarterly* 42, no. 3/4 (2015): 39-51. http://iproxy.inflibnet.ac.in:2060/stable/26316574

Kabraji, Rosheen. "Pakistan: Educating For Tolerance." *The World Today* 67, no. 4 (2011): 21-22. http://iproxy.inflibnet.ac.in:2060/stable/41962644.

Kazi, Aftab A. *Ethnicity and education in nation-building in Pakistan*. Vanguard, 1994.

Khan, Akhtar Hasan, and Naushin Mahmood. "Education in Pakistan: Fifty Years of Neglect [with Comments]." *The Pakistan Development Review* 36, no. 4 (1997): 647-67. http://iproxy.inflibnet.ac.in:2060/stable/41260063.

Khan, Shaukat Hameed. "Making People Employable: Reforming Secondary Education in Pakistan." *The Pakistan Development Review* 48, no. 4 (2009): 603-17. http://iproxy.inflibnet.ac.in:2060/stable/41261337.

Könings, Karen D., Saskia Brand-Gruwel, and Jeroen JG van Merriënboer. "An approach to participatory instructional design in secondary education: an exploratory study." *Educational Research* 52, no. 1 (2010): 45-59.

Nambissan, Geetha B., and Poonam Batra. "Equity and Excellence: Issues in Indian Education." *Social Scientist* 17, no. 9/10 (1989): 56-73. doi:10.2307/3517205.

PANIKKAR, K N. "India's Education Policy: From National to Commercial." *Economic and Political Weekly* 46, no. 17 (2011): 38-42. http://iproxy.inflibnet.ac.in:2060/stable/41152130.

Sen, Amartya. *The Country of First Boys. And other essays*. Oxford University Press, 2015.

Sidhu, Gurkirpal Singh, and Rakesh Jindal. "GATS AND HIGHER EDUCATION : INDIA MOVING TOWARDS GLOBAL MARKETS." *The Indian Journal of Political Science* 67, no. 2 (2006): 381-96. http://iproxy.inflibnet.ac.in:2060/stable/41856224.

ZAIDI, S AKBAR. "A Conspicuous Absence: Teaching and Research on India in Pakistan." *Economic and Political Weekly*44, no. 38 (2009): 57-68. http://iproxy.inflibnet.ac.in:2060/stable/25663571.

Artha Beekshan, Volume 27, No.4, March 2019

MGNREGA: Sustainable Path towards Inclusive Growth

Rivu Sanyal[1], Nabanita De[2], Susmita Banerjee[3]

Abstract

In this paper an effort has been made to analyse theimpact of the scheme on asset creation, food grain production, women participation, social inclusion and financial inclusion.We have examined the sustainability (long run) aspect ofMGNREGS by studying its impact on food grain production and asset creation. In order to understand the relation between the assets generated by MGNREGS and food grain production, a panel regression analysis have been done and our result shows that material expenditure incurred in MGNREGS have significant positive impact on food grain production.This type of programme has gained special attention of the policy makers in the era of 'agrarian crisis', which began in mid-nineties for its potentialities to solve the problem. But, on the other hand, many economists are raising concern over the negative impact MGNREGS may have on labour market due to the general increase in wage rate in post MGNREGS period. These contradictions have made us interested to examine the nature of role played by MGNREGS in rural labour market. In this paper, a critical study has been made with the help of available secondary data to analyse the impact of MGNREGS on rural labour market.In order to examine the inclusive nature of the scheme we have analysedthe workforce participation rate of SCs, STs and women in MGNREGA employment programme. Our study reveals that the percentage of MGNREGA participants, with bank accounts or postal accounts have also increased, across the gender and also in totality, over the year, which ensures the potential of financial inclusiveness of the scheme.

Key Words: ***Poverty, Inclusive Growth, Sustainable Development, MGNREGS, Asset Creation, Productivity***

JEL CLASSIFICATION: Q10, Q01, J38, J43,

I.Introduction

Sustainability can be defined as the practice of maintaining the processes of productivity indefinitely. Sustainable development is the development of present generation without

1. Assistant Professor, Department of Economics, Charuchandra College, Kolkata, e-mail.:rivu_ulu@rediffmail.com

2. Government Approved Part Time Lecturer, Department of Economics, Charuchandra College, Kolkata, denabanita2015@gmail.com

3. Associate Professor, Department of Economics, Charuchandra College, Kolkata, e-mail.: bsusmita@rediffmail.com

compromising the requirement of future generation. In this paper an effort has been made to analyse the sustainability (long run) aspect of MGNREGS by studying its impact on asset creation and food grain production. Besides that, we have also made an attempt to analyse the role it has played to ensure inclusive growth for rural economy, which is one of the greatest challenge for Indian economy even today. Despite achieving more than 8 per cent economic growth, **the trickle-down effect** to reach the benefit of growth to the poor failed. For the country to achieve inclusive growth target, inclusiveness must be translated into poverty reduction through providing livelihood opportunities to the marginalised section of the society. Keeping that in mind, only few years ago the then central government introduced a 'bigger and well-funded' comprehensive employment scheme for the rural poor called, '*Mahatma Gandhi National Rural Employment Guarantee Scheme*' (MGNREGS) or simply NREGS. It came into force in February 2006, initially in 200 selected districts of India with at least one district in each state. According to the then government, it was one of the biggest employment providing programme ever started in a country for the development of its rural poor. It had multiple objectives. On the one hand it was to create job opportunities during agricultural lean season through some public work programmes. It claimed that the act treated employment as a right for rural household. Apart from that, as it is mandatory to generate sustainable community assets under the purview of MGNREGS, this willnot only strengthen the rural infrastructure, but also generate farm and non-farm employment.It was expected that such policy measures would increase the purchasing power of rural people and indirectly help agriculture itself. Moreover, the MGNREGS had a measure of gender sensitivity in its design (wage parity, one-third representation of women in total job created). Data shows that indeed a larger number of women have sought to work under this employment generation programme. At the same time good number of SCs and STs are participating in the scheme, attributing to the socially inclusive nature of the scheme.From 2008, it is mandatory for all the beneficiaries of MGNREGS to open bank or post office account to get the wage. Thus the scheme is also financially inclusive in nature.But the operational dimensions of the MGNREGA have been subject to much debate regarding the efficacy and targeting of the act. MGNREGA has attracted mixed reactions from economists and policy analysts. There has been considerable discussion on whether the employment has been successfully targeted to the poor, or there are leakages to those above the poverty line.Besides that, many economists are raising concern over the negative impact MGNREGS may have on labour market due to the general increase in wage rate in post MGNREGS period. These contradictions have made us interested to examine the nature of role played by MGNREGS.

The purpose of this article is to critically analyze the impact of the scheme upon assets creation in rural India.Along with this we are looking at the effectiveness of the scheme on food grain production,women participation,social inclusion and financial inclusion.The rest of the paper is organized as follows. Section 2 presents survey of existing literature whereas in section 3 objective of the study has stated briefly. Section 4 analyses the data and developed the econometric model and describes the methodology used for its estimation. We discuss our empirical results in section 5. The last section concludes the paper.

II. Literature Review

A recent ILO study concludes that MGNREGA satisfies many of the provisions under Recommendation No. 202, such as “universality of protection”, “entitlement to benefits prescribed by national law”, “social inclusion” and “respect for the rights and dignity of people covered by the social security guarantees” (Ehmke, 2015). The legal framework of MGNREGA also reinforces programme sustainability. However, there are differences of opinion among the economists about the possible impact of the scheme. **Asthana (2013)** stated that there have been some study about the negative impact of MGNREGA on the labour market both in agricultural and industrial sector. Simultaneously with the rise in wages, MGNREGS has been criticized for the non- availability of labour. There is a debate also about the utility of the assets generated by MGNREGS .**Chowdhury(2011)** claimed that wages for agricultural labour have gone up by 2.5 times and agriculture will be a unviable option. **Mishra (2011)**made an attempt to look at the utility of the assets created under MGNREGS in three districts of Madhya Pradesh. It enjoys the potential to lead the economy in to labour intensive growth path through the creation of assets. The assets generated by MGNREGS has been criticized as a futile attempts. The study indicates that there is an impact of the assets generated under MGNREGS on rural household. The productive value of assets could be increased further with proper monitoring. **Ministry of Rural Development (2010)** mentioned that MGNREGS would increase the agricultural productivity and also increase the income of beneficiary families. Adoption of ecologically sound agricultural practices would ensure sustainability of farming. **Ramesh (2013)** claimed that MGNREGS had no negative effect on agricultural sector. According to him, it has increased the employment opportunities in agricultural and related activities and has not substituted them. The permissible work under MGNREGS has extended to include agriculture. It also improved the rural infrastructure. **Ramesh and Mann (2013)** stated that MGNREGS and agriculture are not mutually exclusive. Rather MGNREGS has removed the stagnation of agricultural wage. Both MGNREGA and agricultural growth can increased the agricultural wage and rural development. It thus becomes a definite source of income for small and marginal farmers and marginalized. Simultaneously MGNREGS have increased the soil fertility and land under irrigation. **Mahajan (2012)** clearly rejected the criticism by analyzing that there was only rationalization of net wage rate for the women in post MGNREGS period. But for men there was a fall in net wage rate. **Kulkarni, Ranaware, Narayan and Das (2015)** stated that MGNREGS works supports agriculture and benefit a large number of small and marginal farmers. The assets created are maintained and in a good condition.**Sinha (2013)** in an article measures the environmental and socio-economic benefits generated by the works implemented under MGNREGA. This paper quantifies the potential of these benefits to reduce the vulnerability of agricultural production in the post MGNREGS period. Due to the operationalization of MGNREGS there has been a decline in the agricultural and livelihood vulnerability indices. **Sharma (2014)** in an article tried to judge the relation between MGNREGS and agriculture. The impetus to agriculture will be triggered when there is an assets creation on individual farms. Landless unskilled labourer could also be benefitted from additional employment generated from small farms. Furthermore, the empirical evidence clearly highlighted a decline in livelihood vulnerability index of households. **Poorani and Jahan (2014)** clearly explained the impact of MGNREGS upon agricultural labourer. The agricultural workers in India derive unusually low wages for the work they are doing and live under tremendous misery. MGNREGS aims to provide a steady source of income and livelihood security for the poor and marginalized. Thus it has led to an increase in agricultural wage rate and simultaneously there is a parity of wage**. Merin S and Vineeth (2011)** did a study about the relation between MGNREGS and labour supply in agriculture. The study had found that MGNREGS did play a role in the hike of agricultural wages. The MGNREGS wage acts as a standard minimum wage and keep the labour market wage high. Simultaneously it is required to mention that MGNREGS is not really responsible for the movement of labour from agricultural sector to elsewhere.**Dreze and Khera (2008)** had done a detail study to analyze the impact of MGNREGS, across the six states of India in 2007-08. According to them MGNREGS is making a difference to the lives of rural poor, slowly but surely. Most of the beneficiaries of MGNREGS do belong to the disadvantaged section of the society. According to the survey SCs and STs are joining the scheme in large number. It thus becomes a tool for social equity and economic redistribution as an indication of social engineering. It offers a unique opportunity to the rural backward who rarely got a chance to earn. **Mathur (2007**) claimed that it is easy to criticize MGNREGS without considering what it has already achieved and may promise to offer. It is the first tangible commitment to the marginalized and poor that they can expect to earn a living wage without loss of dignity and demand this as a constitutional right. This is a unique opportunity for India –to herald a remarkable turn in the fortunes of rural deprived. **Sudarshan (2011)** tried to explain the success story of MGNREGS in Kerala, Himachal Pradesh and Rajasthan. A large number of women have sought work under the programme in these states. The Indian government's NREGS (National Rural Employment Guarantee Scheme) has succeeded in bringing large numbers of women into paid work, many of them for the first time. **Chandrasekhar and Ghosh (2009)**in their paper tried to judge the scheme from the question of social inclusion. They found that MGNREGS disproportionately involved women, SCs and STs as workers under the scheme.**Gupta and Fearooz Ahmed (2014)** "MGNREGA & FINANCIAL INCLUSION-A CASE STUDY". They described that some constraints faced by banks and post offices in accelerating the speed of financial inclusion and has been tremendous growth in opening of bank accounts and more awareness camps should be organized in villages to make full awareness of basic banking services among rural people in villages.**Nagaraju (2015),"FINANCIAL INCLUSION AND MGNREGA**". He said that the MGNREG scheme contributed to perhaps the largest financial inclusion drive in rural India in recent times. Workers with individual MGNREGA bank accounts are highest in Kerala (73%) followed by Andhra Pradesh(61%), Tamil Nadu(49%), and Himachal Pradesh(39%). That financial inclusion drives when linked to social security schemes such as MGNREGA can increase the financial inclusion.

After studying the different aspects of MGNREGS and its impact, we find that none of them had done an empirical study based on secondary data combining the multiple dimensions about MGNREGS.So it would be an opportunity to make a study in that direction.

III. Objective

The purpose of this article is to judge the effectiveness of a social sector scheme upon the multiple dimensions of rural development. There are criticisms by some economists about the perceived negative impact of MGNREGS.According to them MGNREGS may pull the agricultural wage rate up and thereby may have a detrimental effect on food grain production.The goal of our study is to resolve the dispute empirically with the help of secondary data.

The objective of our study therefore can be classified into broad dimensions:

1)Effectiveness of the scheme in generating rural assets

2)The impact of the assets generated by MGNREGS on food grain production

3)Effect of the scheme on the aspect of women participation and social inclusion.

4)Potential of the scheme regarding the question of financial inclusion

5) Impact of MGNREGS on agricultural labour market.

IV. Data and Methodology

IV.1: Data

We have used the secondary data available from different sources - RBI, National Sample Survey Organization (NSSO), the official MGNREGS website and the Ministry of agriculture, and analyzed them .The figures and the corresponding graphical presentation are mentioned in an annexure at the end of this article. The total number of assets created (means completed) by MGNREGS and its composition is displayed graphically in the corresponding pie diagram (fig 1). The pie diagram clearly demonstrates the composition of assets creation. This shows the priority of the scheme for the food grain production. Several states have invested a significant amount of money on agriculture works as well as agriculture allied works under the scheme. In fig 2 we have shown state wise data on percentage of total expenditure on agricultural works in 2014-15 vis-à-vis in 2018-19. Data reveals that in 2014-15, Kerala spends highest amount on agriculture work, whereas in 2018-19 Jharkhand spends the most. Expenditure on agriculture has increased for most of the states in 2018-19 compare to 2014-15.

The figure of food grain production in India from 2000-01 to 2017-18 (pre MGNREGS to post MGNREGS) is plotted graphically in fig 3, and the line diagram clearly demonstrates an increasing trend. There is a figure describing the growth rate of agricultural wage of male and female labourer in the pre and post MGNREGS phase (Fig 4 and Fig 5 respectively).These figures are plotted in two different graphs. One diagram is comparing the growth rate of agricultural wage of male labourer for the pre and post MGNREGS period. The other figure is doing a similar graphical study about the female labourer. Both the graphical study are cross sectional in nature. The average growth of agricultural wage in the post MGNREGS period is higher for the female labourer than the male counterpart. There was an increase of agricultural wage of the female labourer. This is shown in fig 6a and fig 6b. Thus MGNREGS is becoming an effective instrument in pulling the agricultural wage up for the women labourer from near stagnation. The difference in wage rate between the female labourer in informal sector and that of MGNREGS wage is clearly acting as a pull factor for the increasing participation of women in MGNREGS.

We have also collected data on national level participation of SCs, STs and women in MGNREGS till 2017-18,the state-wise participation of SCs and STs in MGNREGS and their corresponding share in population for further analysis.The given data shows clearly that the average participation of women in MGNREGS at the national level has followed an increasing trend throughout the time period. But despite the high level of participation of women in MGNREGS, there are variation among the states with respect to the participation of women in MGNREGS. The inter-state variation is largely due to the existing socio-economic differences within the states. This is shown in fig 7a, 7b,7c and 7d. Similarly there are higher participation of SCs and STs in MGNREGS for over the years. However, the participation of SCs and STs in MGNREGS shows decreasing trend. This may be due to the effect of other policy initiatives like provision of food grains at subsidized rate. It is depicted graphically also in fig 8a and 8b. This demonstrated the gender sensitivity of MGNREGS and its inclusive potential. Simultaneously there is a declining trend in rural poverty also in the post MGNREGS period. It is clearly depicted in the fig 9a, 9b and 9c. The financially inclusive potential of MGNREGS is shown graphically. We use the pie-chart to show the state wise share in total bank account, both in totality and also gender wise for the year 2017-18. This is shown in fig 10. Simultaneously in figure 11 we use the bar-diagram to make a comparative study across the states. It shows that Kerala has the highest share of women in total bank account of that respective state.

IV.2: Econometric Framework and Estimation Strategy

In order to understand the relation between the assets generated by MGNREGS and food grain production, we have done a regression analysis. The following variables has been considered to conduct an empirical study. The food grain production is considered as a dependent variable. And the following- material expenditure incurred in constructing the assets under MGNREGS, MGNREGS wage and cropping intensity (percentage) are considered as an independent variables. The data of the above variables are collected across the states since 2008-09 to 2017-18. 2008-09 was the year from when the scheme was extended throughout the country. Thus the variables are cross sectional in nature and are varying over time. So a panel regression equation is formed below to find out the impact of the independent variables upon dependent variable and appropriate test is conducted to analyze the result derived from the regression statistically. The independent variables are chosen carefully to capture both the MGNREGS and non MGNREGS aspects. Cropping intensity (percentage) has been incorporated as an independent variable to find out the impact of a non MGNREGS independent variable and also to widen the ambit of panel regression. The panel regression equation is of the following form-

$$Y_{it}=\alpha + \beta_1 X_{1it}+\beta_2 X_{2it}+\beta_3 X_{3it}+\epsilon_{it}$$

Where ,i=states(1 to 20) and t=time(2008-09 to 2017-18)

The variables Y_{it},X_{1it},X_{2it},X_{3it} are implying respectively food grain production, material expenditure incurred in MGNREGS, MGNREGS wage and cropping intensity(percentage).

IV.3 Testable Hypothesis

The hypothesis can be stated as follows-

Null hypothesis: Material expenditure incurred in MGNREGS (X_{1it}), MGNREGS wage (X_{2it}) and cropping intensity (percentage) (X_{3it}) have no significant impact on food grain production (Y_{it}).

Alternative hypothesis: Material expenditure incurred in MGNREGS (X_{1it}), MGNREGS wage (X_{2it}) and cropping intensity (percentage) (X_{3it}) have a significant impact on food grain production (Y_{it}).

V. Observation and Analysis

The result of the above panel regression under random effect model would be presented as –

Table 1:

```
. xtreg foodgrainy matexp wgx2 croppingint, re

Random-effects GLS regression                   Number of obs      =       120
Group variable: state                           Number of groups   =        20

R-sq:  within  = 0.3677                         Obs per group: min =         6
       between = 0.0219                                        avg =       6.0
       overall = 0.0279                                        max =         6

                                                Wald chi2(3)       =     51.10
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

foodgrainy	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
matexp	-.0879342	.0240335	-3.66	0.000	-.1350389	-.0408294
wgx2	19.81751	6.085157	3.26	0.001	7.890818	31.7442
croppingint	92.52713	26.03525	3.55	0.000	41.49897	143.5553
_cons	-2960.692	4375.383	-0.68	0.499	-11536.28	5614.901
sigma_u	8502.0879					
sigma_e	1365.4586					
rho	.97485532	(fraction of variance due to u_i)				

Source-authors own computation

Implication of Results

1. Regression coefficient of material expenditure incurred under MGNREGS is statistically significant at 5% level of significance,as P value=.000<.05.
2. Regression coefficient of MGNREGS wage is statistically significant at 5% level of significance, as P value=.001<.05.
3. Regression coefficient of cropping intensity(percentage) is statistically significant at 5% level of significance as P value=.000<.05
4. On the basis of given observations, we may reject the null hypothesis as the P-value=.000<.05 at 5% level of significance. Thus the entire regression model is significant.

Therefore all the independent variables-material expenditure incurred in MGNREGS, MGNREGS wage and cropping intensity(percentage) are making positive impact on food grain production. So both the MGNREGS and non MGNREGSvariables do have a significant contribution on food grain production. So, the assets created under MGNREGS will have a complementary relation with food grain production.

VI. Conclusion

Primary aim of the MGNREGSis to provide welfare for the section of population that did not even earn their subsistence living, particularly the SCs, STs and women. It was expected that it will, in turn, curb the problem of distress migration, which is indirect objective of the scheme. So far, the scheme is moderately successful in fulfilling the objective of social inclusiveness as has been elaborated in this paper. Huge number of people from SC and ST categories took part in the scheme. Participation of women have also increased remarkably, though there is huge variation among the different states. All these measures in the Act make MGNREGA more inclusive in nature.

MGNREGA has helped in achieving financial inclusion of the lower strata of the society. In most of the states, MGNREGA workers are paid through their accounts in banks and post offices. Percentage of MGNREGA participants, with bank accounts or postal accounts have also increased, across the gender and also in totality, over the year. This ensures the potential of financial inclusiveness of the scheme. The scheme gives the opportunity to these informal sectors to get benefit of the organised formal financial sector. From the graphical analysis provided in this paper, it is evident that agricultural wages have increased across the country for both male and female labourers. The rate of growth of female wage is higher compared to their male counterpart during the period of 2004-2009. But it again came down below the growth rate of male wage during the period of 2009-2014. The above result proves the gender sensitivity of the scheme. Thus the scheme **not only ensures financial inclusion of marginalized groups but also ensures social justice for them. Informal women laborers get a platform to develop their status financially, and can enjoy livelihood outside their family. In this way the scheme addressed the issue of women empowerment effectively.**

Most of the marginalized groups in the rural areas are small and marginal land holders, their lands were sterile. Under this scheme, marginalized groups, for example SCs, STs and others, are allowed to improve their own private lands, which makes their lands more fertile. These groups now became the producers of the agriculture products by themselves, they no more - depend on the earning from wages. Another achievement is productivity of crop also increased by the groups of small and marginal farmers - This improvement happened due to the improve techniques used to get ground water and conservation of soil -. In the villages, the infrastructures are developed under this scheme, which is of prime importance for the development of the rural areas. MGNREGA also raises the agricultural productivity through asset creation. The complementary relation between MGNREGS and food grain production can be easily represented with the help of regression analysis. Our result shows that material expenditure incurred in MGNREGS have significant positive impact on food grain production. Despite few shortcomings about MGNREGS the complimentary relation between MGNREGS and agriculture is certainly creating a conducive atmosphere for MGNREGS to be sustainable in the long run. But still ample unexplored opportunities are there to expand the ambit of convergence of MGNREGS beyond agriculture. We can conclude -that a success in short span of time does not necessarily imply a development for rural India and particularly the marginalized groups in long run. Thus if the government wants to persist with MGNREGS, it is important that proper policies are formulated so that in the long run sustainable development can be ensured. There are possibilities of convergence of MGNREGS with social development programme like National Literacy Mission, National Rural Health Mission, ICDS for women and child development, SGSY for skill enhancement etc. MGNREGS with its inter-sectoral approach opens up opportunities for convergence of different schemes and this convergence will multiply the expected benefit of the beneficiaries(direct or indirect).The convergence approach has the potential to achieve the ultimate objective when the beneficiaries of MGNREGS can survive even without its support.

Reference:

Asthana (2013): 'Why NREGA Wage Hike is Bad News for the Economy: Politics of Populism will Impact the Government's Fightback against Inflation', *Business Standard*, November 25.

Chandrasekar, C.P. and Ghosh, J. (2011) *Public Works and Wages in India*. January 11, (www.thehindubusinessline.com).

Chowdhury (2011): "Employment in India: What Does the Latest Data Show", *Economic and Political Weekly*, XLVI (53). 26-32. March, 2011.

Dreze ,J&Khera, Reetika (2008): "The battle for employment guarantees": Hindu Frontline 26 (1)

Ehmke. E.(2015): 'National Experience in Building Social Protection Floors: India's Mahatma Gandhi National Rural Employment Guarantee Scheme', (ESS Paper, No. 49), *International Social Security Review,* Vol.69, page 4.

Government of India - *Agricultural Wages in India 2015-16*, Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi.

Gupta and Fearooz Ahmed (2014): "Impact Analysis of MGNREGA in District Rajouri (J&K state)- A Case Study", *School of Management Studies*, Synopsis for Ph. D. Registration. Available at www.shodhganga.inflibnet.ac.in

Indian Labour Statistics, Labour Bureau, Department of Labour and Employment, Shimla. Labour Bureau Website (www.labourbureau.gov.in)

Department of Agriculture and Co-operation, Government of India, www.agricoop.nic.in

Kulkarni, Ranaware, Narayan and Das (2015): 'MGNREGA Works and Their Impacts A Study of Maharashtra', *Economic & Political Weekly*, MARCH 28, vol 50 no 13, PP. 53-61.

Labour Bureau (2004), *Rural Labour Enquiry Report on Employment and Unemployment of rural Labour Households 1999-2000*, Ministry of Labour Government of India, Shimla

Mahajan, K (2012): 'Agricultural Wages and NREGA: Exploring the Myth', *Live Mint,* Mon, Nov 05 2012.

Merin S and Vineeth (2011): 'Impact of MGNREGS on Labour Supply in the Agriculture Sector of Wayanad District, Kerala', *Agricultural Economics Research Review* ,Vol. 25(No.1) January-June 2012 pp 151-155, *Online published on 22 November, 2011*.

MGNREGS official website : http://nrega.nic.in

MGNREGS Sameeksha (2012*): An Anthology of Research Studies on the MGNREGA, 2005,2006-12,* edited and complied by Mihir Shah, Neelakshi Mann and VaradPande, Ministry of Rural Development(MORD, Government of India), New Delhi: Orient Black Swan

National Sample Survey Organisation (2004): *Wage Rates in Rural India – 2003-04*, New Delhi.

Nagaraju D.(2015),"Financial Inclusion And MGNREGA", *Research Dimensions,* Vol.2, issue 9, March

Poorani and Jahan (2014): 'Impact of MGNREGS on Agricultural Labourers'. *Indian Streams Research Journal,* Vol. IV, Issue. V, http://isrj.org/UploadedData/4931.pdf

Ramesh and Mann (2013): 'Rising Farm Wages Will Lift All Boats'. *The Hindu*, May 14.

Ramesh, Jairam (2013): MGNREGS had no Adverse Impact on Agricultural Sector. *The Hindu,* 22/08/2013

Sharma (2014): "MGNREGA- An Alternative to Migration," *Kurukshetra*, 2014, Vol. 62 (11), pp 26-28.

Sinha (2013): 'Agricultural and Livelihood Vulnerability Reduction through the MGNREGA', *Economic & Political Weekly*, December 28, vol XLVIII, no 52 , pp. 94-103.

Sudarshan, M. & Ratna, S., (2011) India's NREGA: women' participation and impacts in Himachal Pradesh, Kerala and Rajasthan; CSP Research Project 06

Annexure:

ASSETS	NUMBER OF PROJECTS COMPLETED(IN LAKHS)	PERCENTAGE
RURAL CONNECTIVITY	38.49	24.24
WATER CONSERVATION & HARVESTING	21.13	13.3
MICRO IRRIGATION	11.14	7.01
RENOVATION OF TRADITIONALWATER BODIES	14.36	9.04
FLOOD CONTROL	8.56	5.39
DROUGHT PROOFING	14.44	9.09
LAND DEVELOPMENT	29.4	18.51
WORKS ON INDIVIDUAL LAND	21.25	13.38

Source-www.mgnrega.nic.in

Artha Beekshan, Volume 27, No.4, March 2019

LOW GROWTH AND EMPLOYMENT, TOTAL FACTOR PRODUCTIVITY AND "MISSING MIDDLE" IN INDIAN MANUFACTURING: THE PLAUSIBLE INTERVENTION OF INFORMATION AND COMMUNICATION TECHNOLOGY

Sujatra Bhattacharyya#

Abstract

India's manufacturing sector is a matter of interest among the economists due to its unexpectedly unimpressive contribution towards the growth of the nation's GDP and growth of employment. Since the independence, the unusual performance of the sector acted as a frustrating truth in the national growth experience. Compared to the other Asian nations, the performance of the sector is miserably poor. The national manufacturing policy (2012) seriously looked into the facts and aimed at increasing the share of the manufacturing sector to 25% by 2022. However the sector is characterised by low growth rate along with low employment mainly due to lack of skills. Apart from this, the sector is dominated by the unorganized segment where the productivity is extremely low.

Information and communication technology (ICT) refers to the digital processing, storage and communication of information of all kinds. It has the potential to be used in every sector of the economy. In this study we will try to examine the impact of information and communication technology on the Indian manufacturing growth, total factor productivity. The analysis also focuses on the possibility of skill formation and employment growth in the sector through successful implementation of ICT. The phenomenon of "missing middle" in this sector acts as one of the hindrances for ICT intervention in the sector. Still our analysis finds some positive and significant impact of ICT on growth, productivity and employment in the manufacturing sector.

I.INTRODUCTION

The manufacturing performance of India in terms of growth and productivity is practically unimpressive over the years. The objective of this paper is to establish the influence of information technology on the manufacturing productivity in India. Indian manufacturing sector is characterised by tremendous dominance of unorganised segment, where the usage of IT is minimal. Unfortunately the proportion of organised segment, which has the intention

---

Assitant Professor of Economics,Maharaja Srischandra College, Kolkata.

to use IT intensively, is very low. The productivity is very high in this segment, whereas it is extremely low in the unorganised manufacturing, which is actually dominating the show.

Information technology (IT) refers to the digital processing, storage and communication of information of all kinds. It has the potential to be used in every sector of the economy. Information technology (IT) refers to the digital processing, storage and communication of information of all kinds. It is often argued that IT sector can be an important source of growth for India, as the nation has a comparative advantage in providing certain IT-related products and IT-enabled services. It is often expected that the development of IT sector in India, has a positive spill-over benefits to the rest of the economy and hence lead to an overall development. However the chance of IT-led productivity improvement is not that bright due to various factors. The problem of 'missing middle' is one of the bottlenecks to apply technological innovations successfully in the manufacturing sector. The dominance of unorganised segment in this sector acts as a threat to the intervention of ICT. Still there are some evidences of IT-led improvement in total factor productivity. To improve the productivity the IT should be intensively used along with institutional reforms and infrastructural investment. The role of other complementary inputs is also vital here.

In section I we will discuss the themes of the existing studies and show the possible intervention of ICT in the growth of the manufacturing sector In section II, we will determine and analyse the impact of the role of ICT in the total factor productivity of the manufacturing sector of India. Section-III will reveal the data source and methodology of the analysis. The section IV will focus on the problem of "missing middle" and probable ICT-led solutions.

II. ICT AND MANUFACTURING GROWTH

Manufacturing sector is the most important segment of the industry and in many nations the manufacturing sector contributes a lot to the gross domestic product of the economy. In this section we initially review some of the existing papers regarding the relationship between Indian ICT and manufacturing production. In this section our study will examine the significance of per capita value added of ICT on per capita value added of manufacturing sector.

At first we can highlight the opinions of Sharma and Singh (2012), who in their study illustrated the relationship between IT and productivity in the Indian manufacturing. They used five years of panel data to show the contribution of IT in manufacturing productivity. They had mentioned the unusual role of Indian manufacturing sector in the national growth scenario. In most of the times, the contribution of manufacturing sector to GDP was unsatisfactory and below the target. The Government was seriously concerned in this matter and adopted new National Manufacturing Policy (NMP) 2012. Regarding employment perspective, the performance of Indian manufacturing was also quite unimpressive compared to those nations, especially South Korea. Panagariya (2008) had identified the slow movement of the workforce from agricultural to the organised manufacturing sector as the key factor for this poor rate of employment growth in the Indian manufacturing sector. He also stressed on the dependence and complementarity between manufacturing and service sector for positive impact on employment generation.

Sharma and Singh (2012) mentioned the special role of software industry in improving the balance of payments situation of the country and its positive contribution to the information technology enabled services (ITES). The growth was mainly export-oriented and the only existing threat is the question of sustainability of this external demand. The problem of 'digital divide' is also a vital one indicating inequality in accessing the new digital technology throughout the country. Sharma and Singh, in their study had shown strong and positive impact of ICT on manufacturing productivity. In most of the cases, the firms with more IT usage and stock have shown a significant rise in productivity. Chandra and Sastry (2002) were extremely critical about the Indian manufacturing management as the manufacturing policy did not recognise the importance of competition, product and process innovations, reduction of cost and expenses on R & D. Their study also pointed out the lack of well trained and advanced personnel in the sector. Priority was not given to information technology–related investment in the manufacturing sector. Most of the firms were reluctant to use ICT in their operations. The supply chain management was very weak and accordingly information sharing through the supply chain became a remote possibility. However some studies found significant increases in the IT usage in the particular areas of manufacturing, but overall scenario was depressing due to limited use of IT.

Basically, the limited adoption of IT in the Indian manufacturing sector is the main bottleneck, although IT has a tremendous potential to improve the productive efficiency of the manufacturing unit. It is observed that the firms with higher gross value added have higher stock of information technology. The adoption of ICT requires proper infrastructural facilities. In India, the role of financial constraints as the main barrier to IT investment is fortunately greater compared to the infrastructural constraints. However, in spite of proper IT investment, a manufacturing unit may fail to raise its productivity due to inefficient complementary inputs and inappropriate management. So it is not very easy to conclude that proper IT investment always can raise the manufacturing productivity. We have to take many related issues and barriers in consideration.

Some studies criticised the nature of Indian manufacturing due to its reluctance to adopt new technologies, process and product innovation and most importantly the lack of spending on research and development (Chandra and Sastry, 2002). The study had shown its concern over the low priority of Indian firms for investing in various IT-related applications. However things had changed a lot these days, and Indian manufacturing sector is slowly realizing the possible positive impact of ICT on this very sector. Unfortunately, apart from very large firms, most of the other manufacturing units in India failed to achieve a low-cost and viable IT solution. One of the reasons for this was the fear of adopting a new technology.

Gangopadhyay et al. (2008) conducted empirical study of the impact of IT on Indian manufacturing. They used ASI data to determine the factors for usage of ICT in Indian manufacturing units. Their study also tried to assess the impact of IT on Indian manufacturing sector. The study revealed that non-availability of short term finance and shortage of electricity was the main bottlenecks for using IT in the manufacturing sector. This makes sense to the argument that the firms with greater IT adoption and usage can be more productive and profitable than the others which were not using or applying IT in their operations. The problem here is the lack of any clear cut evidence of the special role of IT in increasing the productivity and performance of the sector. It is often argued that, better or superior management quality can also raise the level of productivity and it can play a vital and effective role in using IT in the manufacturing sector.

Our study focused on the impact of per capita ICT (pc_ict) on per capita manufacturing (pc_mfc) and total factor productivity. The review period is 1991 to 2016 for manufacturing and 1991 to 2015 for TFP. Naturally, 1991 is taken as the initial year of the review, as in this year India adopted new economic policy which led to liberalisation, privatisation, and globalisation.

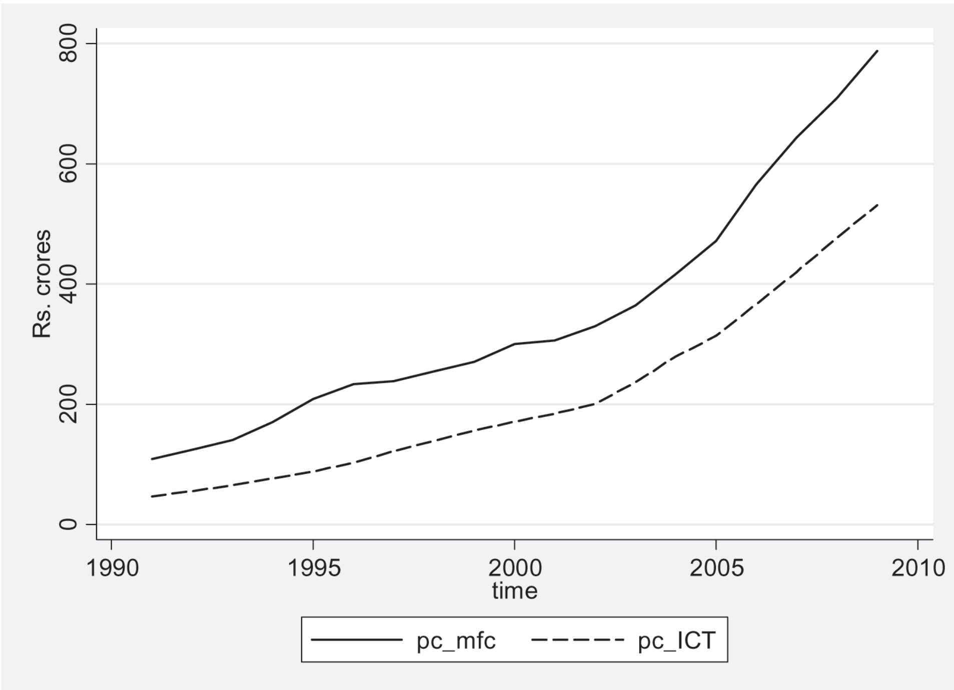
We have performed regression by assuming per capita ICT (pc_ict) as the independent variable and per capita manufacturing (pc_mfc) as the dependent variable. Per capita total transport (pc_tot_trans) and openness have been treated as the control variables. Our research established a close relationship between per capita ICT and per capita manufacturing. Our regression results revealed that ICT has a significant effect on manufacturing ($t = 55.66$). The coefficient of ICT is 1.35, indicating a considerable amount of dependence of the manufacturing sector on ICT. A unit change in per capita ICT can bring about 1.35 units change in per capita manufacturing output. The openness and per capita total transport also have been found to be significant in affecting per capita manufacturing (See Table-1). It should be mentioned that here per capita total transport is the sum of gross value added of rail transport and gross value added of other transport divided by population. We also define openness as the sum of the value of exports and value of imports as a percentage of gross domestic products.

Now we will focus on the trend in per capita ICT and per capita manufacturing in figure-1below. From this one can understand the behavioural pattern of per capita manufacturing relative to per capita ICT.

The figure suggests upward trend for both per capita ICT and per capita manufacturing. Even in the years of depression and external shock per capita ICT maintained its upward trend as mentioned earlier. Per capita manufacturing also recorded an impressive growth rate specifically after 2004-05. It can also be shown that in spite of the high rate of rise in the population growth in the next few years, the manufacturing per capita has recorded a steady performance The regression analysis suggests significant contribution of ICT in the growth of the manufacturing sector which is also depicted in the figure.

One of the possible reasons for the ICT-led growth in manufacturing may be the use of ICT in the production process. Along with the production of equipment ICT seems to play a major role in the production process in the manufacturing sector. ICT-led product innovation coupled with process innovation creates the possibilities of higher growth rate in manufacturing output in the near future. Thus ICT brings substantial knowledge in the manufacturing sector in terms of product and process which give birth of technological advances in the said sector.

FIGURE-1:PER CAPITA ICT AND PER CAPITA MANUFACTURING IN INDIA DURING 1991-2010



Source : CSO, National Income Statistics, CMIE, Various Issues And Author's Calculation

The joint study made by the National Manufacturing Competitiveness Council (NMCC) and the National Association of Software and Services Companies (NASSCOM), as mentioned in the article by Sharma and Singh (2012), presented a comparatively bright picture, which is a bit consistent with our study. (NMCC-NASSCOM Report, 2010) clearly expressed the necessity of IT adoption in the manufacturing sector. The study focused on promoting ICT for the development of the manufacturing sector. The report mentioned various hurdles like lack of infrastructure, lack of awareness, and internal capabilities etc, for the adoption of IT in the manufacturing firms. It also specifically highlighted the weakness of supply chain in this context. At the same time it had reminded the potentiality of ICT if used effectively in the manufacturing sector.

However the penetration level of ICT in the Indian organised manufacturing sector is not that low, which can be reflected in our result. After liberalisation, application of computer-aided design (CAD), and computer-aided manufacture (CAM), computer-aided engineering (CAE), and computer integrated manufacturing (CIM) was extremely important. The knowledge-based education as obtained from IT creates economies of scale as well as economies of scope in production. Apart from this, ICT has the potential to reduce the information asymmetry. This can generate cost-effective output. Moreover, the proper application of ICT leads to smoothening of resource distribution and utilisation which have a positive impact on manufacturing productivity. The issue of R &D, product and process innovation in the manufacturing sector is hugely facilitated by adoption of ICT by the manufacturing firms. The government provided the training programmes to the workers to improve the skill, quality and efficiency so that they can be accustomed with the IT usage. All these factors are important to explain the reasons for possible significant contribution of per capita ICT on the per capita manufacturing in India. Thus our research is almost in the line of the findings of Mitra et al. (2011) where it was suggested that ICT infrastructure plays a significant role in the development of manufacturing sector of India.

III. Impact Of ICT On Total Factor Productivity (TFP) And Growth Of TFP

In this section, we will also analyse the issue of total factor productivity (TFP) and total factor productivity growth (TFPG). In addition to this, we will also try to show the impact of domestic ICT on TFP and total IT on TFPG in the manufacturing sector.

Total factor productivity growth (TFPG) in manufacturing sector is an important issue to be considered in the context of adoption of information and communication technology. Mitra (1999) mentioned the importance of TFPG in ensuring growth, especially in the developing economies. Goldar (1986) opined that industrial growth in the developing economies like India was very rarely accompanied with the growth in productivity. Hence it is extremely important to consider the impact of IT or ICT on total factor productivity, especially in the manufacturing sector.

Mitra et. al. (2011) in their study had shown the impact of infrastructure and ICT on technical efficiency and total factor productivity (TFP) in Indian manufacturing. This study was different from the earlier studies as it used advanced estimation techniques to get rid of the problems of non-stationary omitted variables and reverse causality. The novelty of this paper was its assessment of the impact of infrastructure and ICT on technical efficiency. Moreover, to avoid the problem of multicollinearity, the authors, by using principal component analysis, constructed two composite indicators of infrastructure and ICT. Apart from this, instead of OLS the paper used Fully Modified OLS (FMOLS) for estimation, which is supposed to take care of the endogeneity problem.

The study by Mitra et al. (2011) is extremely important in the context of our research, as it estimated the impact of ICT on TFP. However the study considered eight industry groups like food and beverages, chemicals, metal and metal products, transport equipment, textiles, non-metallic minerals, machinery and miscellaneous manufacturing. Though the authors considered the effects of both infrastructure and ICT on TE and TFP, we are only concerned about the effect of ICT on TFP. The review period was taken from 1994 to 2015. The impact of ICT on TFP is pretty interesting.

The results were suggestive of close interlinkage between ICT and manufacturing productivity. The authors found a positive and statistically significant impact of ICT of 18 %-22 % on TFP of textile, transport equipment, metal and metal product industry. The effect of ICT on the TFP of overall manufacturing was also significant and sizeable according to the authors' calculation and it was estimated as 12 %. The study included some additional control variables in this regard, which were trade intensity, research and development, and size of the industry. The authors were of the opinion that a country can ensure development by enhancing basic and ICT infrastructures, specifically in the sectors more sensitive to infrastructure deficiency. The role of ICT was very important in the sense that, it can spur innovation as well, along with growth. .

In our analysis, we have taken total factor productivity instead of labour productivity as it is more useful over the long run. Our study also has tried to assess the impact of per capita ICT on total factor productivity (TFP) in the manufacturing sector. However, the review period is 1991-2012. We have used the TFP index for organized manufacturing sector using GAA index from a study by Trivedi et.al. (2011). To find the impact of per capita ICT on TFP in the organised manufacturing sector, we have taken per capita total transport and openness as the covariates. Regarding total factor productivity, our study has found a positive and significant impact of per capita ICT on TFP. Interestingly, openness has also a significant impact on TFP (t= 13.03). The co-efficient has the value of 1.18, which implies that more openness can improve TFP in the organised manufacturing sector considerably (See Table-1). This is indicative of an improvement in manufacturing output and productivity after economic liberalisation in India after 1991.

As we have mentioned earlier, Mitra et al. (2011) estimated the impact of ICT on TFP of eight core industry groups and found significant contribution of ICT infrastructure on the TFP of metal, transport equipment, and textile industry which were relatively more exposed to foreign or international competition. This implies trade liberalisation had a considerable impact on productivity gains of these sectors. Our research work in this context also supports this argument; where we have shown that trade liberalisation in the form of openness ensure the productivity gains in the organised manufacturing.

However, domestic ICT is able to create a significant impact on TFP of organised manufacturing (See Table-1). We have also regressed TFP on total ICT. We have added total import of IT and ITES with domestic production of ICT to obtain the total IT. We found that both total ICT and openness has a positive and significant effect on TFP (See Table-1 and Table-2). However in a separate model we have regressed TFPG (obtained from Malmquist Index) on per capita total IT and openness. We observe that total IT has an almost positive and significant effect on TFPG (t= 1.91). However the openness had a negative and significant impact on TFPG (See Table-3).

These results are also not surprising in the context of Indian manufacturing sector. Most of the existing studies pointed out the deceleration of the TFP growth in the nineties compared to that in the eighties. The application of ICT in Indian manufacturing was evident in the nineties, but this deceleration was possibly due to poor capacity utilisation. However, some studies attributed this to the lag between reforms and productivity growth. In the unorganised manufacturing, TFPG declined steadily in the period between 1994 and 2005 (Kathuria et al. 2005). During the time period between 1980 and 2004, TFPG was high in case of machinery and transport equipment (MTE) and chemical industry (CHEM),where the possibility of using ICT is high, but the disastrous performance of food, beverages and tobacco (FBT) and textile industry (TEX) were responsible for pulling down the TFPG for manufacturing sector as a whole.

Many existing studies had provided evidences of improvement in manufacturing productivity from the use of ICT. However, Kraemer and Dedrick (1999) criticised these ideas and questioned the validity of the empirical investigations in this context. They pointed out that the firm-level researches only captured the gains and losses of the individual firms—the net gains of the economy were unexplored. Moreover, the firm-level researches mainly focused on the large enterprises, so from that no impression on the entire economic situation can be made. It can also be said that huge returns from ICT investment did not imply productivity improvement. Mitra et al. (2011) found that the impact of ICT on TFP was not very much significant and it was quite low compared to the impact of infrastructure on TFP in the organised manufacturing sector of India. Thus the findings of our study are consistent with these existing studies mentioned above.

We have found that, for ICT-led improvement in TFP in the Indian organised manufacturing sector, the role of complementary factors is very important. Specifically openness or lesser degree of trade barrier is an important determinant of TFPG. In India we observe very slow and phased reduction and elimination of trade barriers and hence often the application of ICT failed to improve the TFP in the nineties. Apart from this, investment is an important complementary input of ICT. Due to poor capacity utilisation often higher investment was not conducive for the growth in TFP. It has been pointed out by some economists that greater investment sometimes lead to diminishing returns and fall in TFPG. In India this actually nullified the ICT-led growth in TFP in the organised manufacturing. Another important bottleneck for the insignificant impact of ICT on TFP in the organised manufacturing sector of some nations was the lack of proper infrastructure. Inadequate infrastructure acted as a serious constraint to the IT-induced productivity improvement in the organised manufacturing there.

We can also identify the ‘demand’ factor as another crucial factor for this insignificant impact of ICT on TFP of organised manufacturing. Ahluwalia (1991) mentioned the presence of agricultural growth constraint in the manufacturing sector of India. His study had shown that unless the agricultural sector provides raw materials to the manufacturing sector and absorbs the intermediate and finished manufacturing goods, there will be huge unutilised capacity in the manufacturing sector. This will have a negative impact on TFPG. Moreover we know that, agriculture still employs the majority of the population and hence unless the growth rate of agricultural sector improves, the demand for manufacturing goods will not improve significantly. Even in terms of income, we observe the declining contribution of agriculture in the national income over the years. Thus the manufacturing sector is bound to find its buyers from services and manufacturing sector instead of agricultural sector. This is also responsible for hampering the ICT-generated TFP growth in Indian organised manufacturing sector.

The negatively significant impact of openness on TFPG implies that higher degree of openness will lead to a deceleration in TFPG. As openness increases, the import of resources will also increase. These resources are not effectively and efficiently utilised in the Indian manufacturing sector. Thus inefficient utilisation of resources is responsible for the negative impact of openness on TFPG. Moreover, greater usage of inputs also may lead to diminishing returns—thus TFPG can decline with higher degree of openness and greater usage of imported technology and inputs. This result is somewhat consistent with the findings of Krugman (2004), as we have mentioned earlier.

In spite of these bottlenecks, ICT has the potential to bring an improvement in TFP in the organised manufacturing sector of India, as evident from our regression analysis. The above-mentioned complementary factors should work hand in hand to ensure impressive ICT-led TFP growth here.

Thus the results along with the analytical discussion revealed that ICT or IT can have a significant impact on the manufacturing sector of Indian economy. There should be more integration among the manufacturing units and well defined supply-chain mechanism to remove the information asymmetry prevailing in the sector.

ICT Regression Results

We have selected the manufacturing sector to investigate the effect of the use of ICT. The review period is 1991 to 2016. The details about data and methodology have been discussed below.

Data: Sources and Calculations

We have obtained the gross domestic products, Manufacturing for the economy as a whole, at current prices, from the Planning Commission Website (http://planningcommission.nic.in/data/datatable/). The original source of the DATA is the CSO. The data on Communication have been taken from the various issues of the National Income Statistics of the Centre for Monitoring Indian Economy (CMIE).The data on total output for IT have been taken from the various issues of the CMIE Industry: Financial Aggregates and Ratios. The data is given at current prices. But from 2003-04 onwards the 'value of output' figures are not available. We found that the 'sales' figures are comparable to the value of output figures. According to the details given in the issues the value of output corresponds to the net sales plus change in inventories. But the change in inventories was negligible. So we took the 'Sales' figure where the 'value of output' was missing. From the various issues of the CMIE Industry data we have compared the data for the years present in several series. We found the 'information technology' data comparable to the 'computer software and hardware' data. Since our objective is to establish the link between ICT and the growth and productivity of the manufacturing sector of Indian economy, we have added the total product of the IT with that of communication to obtain the values of the total production of ICT in the economy for each year. We have also checked and compared the results with the Annual Reports Department of IT, Ministry of IT.

To investigate the effect of ICT on the manufacturing sector we have calculated the per capita figures for each sector. The calculation of the labour productivity for these sectors required the sector specific employment figures for each year of the review period. This is hard to come by. To overcome the data availability problem in this respect we have obtained the per capita value added for all the sectors. We have obtained the mid-year population figures for each year of the review period, from the CMIE National Income Statistics. We have taken the sum of export and import as a percentage of the GDP as an index for openness. The year on year export and import figures have been obtained from Foreign Trade and Balance of Payments, different issues of CMIE.

Total factor productivity (TFP) has gained much importance in economic literature in the past few years. We have also studied the impact of ICT on TFP in manufacturing sector. We have used the TFP index for organized manufacturing sector using GAA index and Total Factor Productivity Growth (TFPG) from Malmquist index from a study by Trivedi et.al.(RBI, Study no.37). In order to assess the impact of openness and total ICT on TFP we have added domestic production of ICT with import of ICT

METHODOLOGY: THE MODELS

To study the impact of the ICT on the manufacturing sectors of the Indian economy, we have formed an equations for the manufacturing sectorof the economy. It should be noted that to study the impact of the information and communication technology, we have added the value of output figures for IT and communication as obtained from the several data sources discussed previously.The relevant models are given below.

1. $pc\_mfc = \beta_0 + \beta_1 pc\_ict + \beta_2 pc\_tot\_trans + \beta_3 openness + e$
2. $tfp = \beta_0 + \beta_1 pc\_ict + \beta_2 pc\_tot\_trans + \beta_3 openness + e$

Where :

pc_mfc: per capita value added in manufacturing

pc_tot_trans: (GVA in Rail transport + GVA in other transport)/population

pc_ict: (total value of output of IT + GVA in communication)/population

tfp = Total Factor Productivity in Indian Manufacturing

Moreover we have constructed two other models to determine the impact of total ICT and openness on total factor productivity and total factor productivity growth. These models are given by the following two equations.

$$tfp = \beta_0 + \beta_1 pc\_tot\_ICT + e$$

$$tfpg = \beta_0 + \beta_1 pc\_tot\_ICT + \beta_2 openness + e$$

Where—

pc_tot_ict = per capita total ICT

tfpg= Total Factor Productivity Growth

We have run separate regressions for each of the equations on STATA.

Results

The results of the regression is given in the table below. The figures in the parenthesis show the t value.

ICT has a significant effect on manufacturing (t = 55.66). The coefficient of ICT is 1.35, indicating a considerable amount of dependence of the manufacturing sector on ICT. A unit change in ICT can bring about 1.35 units change in per capita manufacturing output.

TFP in organized manufacturing: The regression result projects positive and significant impact of ICT on the TFP. Also the index of openness has a significant positive impact on the TFP. This is an important result as it stresses the importance of trade in improving efficiency and productivity of the manufacturing sector.

Regarding the impact of total ICT on TFP and TFPG, we have obtained the following results. Total ICT and openness are found to be significant in affecting TFP in the manufacturing sector (See Table-1 & 2). However, the per capita total ICT has almost a positive significant effect on TFPG. Interestingly, openness has a significantly negative impact on TFPG in the manufacturing sector (See Table-3)

The results of regression are presented in the following table

TABLE-1

	Pc_ict	**Pc_tot_trans**	**openness**
Pc_mfc	**1.353224** **(55.66)**	**2.286766** **(47.16)**	**25.56711** **(16.38**
tfp	**0.0631** **(10.67)**	**0.104** **(10.62)**	**1.18** **(13.03)**

TABLE-2

	Pc_tot_ict	R^2
tfp	0.06 (8.53)	0.88

TABLE-3

	Pc_tot_ict	openness	R^2
tfpg	0.098 (1.91)	-2.28 (-2.23)	0.50

Thus in this study we have assessed the impact of ICT on the manufacturing sector of the economy. Interestingly the impact of ICT on agriculture is found to be significant due to the improved penetration level in recent times. The ICT have a positive and significant effect on the growth of the manufacturing sector. The impact of domestic ICT on total factor productivity is significant. On the other hand, total ICT has an almost positive and significant effect on the total factor productivity growth. Thus here we have presented the role of ICT in the growth. productivity and employment perspective in the manufacturing sector and found that along with the complementary inputs it is capable of ensuring long-term growth.

IV. The Problem of "Missing Middle" and Possible Adoption Of ICT in the Manufacturing Sector For Skill Formation And Employment Growth

Indian manufacturing sector is characterised by a prominent and dominant presence of the unorganised sector along with the formal or organised sector. The organised sector, according to the Factory Act, refers to a unit which has ten or more workers. The unorganised manufacturing comprises Own-account manufacturing enterprises (OAME), Non-directory manufacturing establishments (NDME) and Directory manufacturing establishments (DME). OAME are household enterprises which use only one family labour. NDME employ at least one hired worker and the total employment will vary between 2 and 5. DME should also have at least one hired worker among the total employment of 6 to 9.

In 2000-01, the distribution of employment as a percentage of all manufacturing was 55.9 in OAME, 12.4 in NDME, 14.4 in DME and only 17.3 in the organised manufacturing sector. This implies that 82.7% of the total workers in Indian manufacturing sector were working in the unorganised manufacturing in 2000-01, but the distribution of value-added was 84.3% in the organised sector. The mean value-added per worker was Rs 6929 in OAME, Rs 18479 in NDME, Rs 20800 in DME and Rs 163775 in the organised sector. If the productivity of the organised sector was assumed to be 100, then it was 4.2 in OAME, 11.3 in NDME and 12.7 in DME. All these evidences suggest the dominance of the household sector and its low productivity in Indian manufacturing (Mazumdar & Sarkar, 2008). The productivity and mean value-added were quite impressive in case of organised manufacturing sector, but unfortunately, only 17.3% of the total workers were employed in this segment of Indian manufacturing. This situation did not improve much even after one and half of a decade.

Mazumdar and Sarkar (2008) clearly emphasised on the Indian dualistic structure with a bipolar distribution. Employment in Indian manufacturing is highest in the firms having employment between 5 and 9, followed by the firms having more than five hundred employees. Employment in the intermediate middle-size groups is very small. This phenomenon is often called the 'missing middle' in Indian manufacturing. Even after liberalisation, the situation remained more or less the same. Economic reforms along with new industrial policy of 1991 led to the dismantling of reservation for the small establishments, liberalisation of import controls, and relaxation of the licensing policy. Even after adoption of these policies the labour absorption in the organised sector remained quite low.

This dualism in the structure affected the manufacturing performance adversely. The prime issue of concern is the loss in welfare and increased inequality. The study by Little et al. (1987) revealed that, the wage rate of the manual labours is almost twice in the larger firms (which have more than one thousand workers) compared to the manual labours of small enterprises (having less than ten workers) if the provision of skill, education, training, etc. are provided to both types of firms. This not only led to increased inequality in the distribution of wage rates but also a loss of welfare in terms of allocative efficiency. Moreover, this dualism was responsible for slowing down of the growth of skilled labour force. The shortage of skilled labour was one of the reasons for the low employment elasticity at that time. Another important problem that emerged from this 'missing middle' phenomenon was the segmentation of the product markets. The small scale local producers started catering to the low-income consumers with low quality products and the demand of limited number of high-income consumers were served by the large enterprises through the supply of high quality product. Thus the sector experienced a lack of coordination and integration among the markets, which in turn led to the dampening of the growth of the markets.

From this analysis it can be said that the unorganised manufacturing segment of the manufacturing sector is the dominating one in terms of distribution of employment. The mean value added and productivity of a labour is quite high in the organised sector compared to the unorganised one, as it mainly employs skilled labour. As a major part of the employment was concentrated in unorganised manufacturing, which was characterised by a very limited use of IT, still our study revealed significant effect of IT on the overall manufacturing productivity. This fact indicates a huge scope for improvement in the unorganised segment by skill formation. In this context the role of ICT is very important. ICT can improve the quality of labour by providing knowledge, training and skill. The increased employment of skilled labour will definitely raise the productivity of the unorganised sector and as a result the manufacturing output in the unorganised sector as well as the total manufacturing output will increase. The skill formation will reduce the wage inequality, raise the employment elasticity and naturally prevent the segmentation of the product market. All these are suggestive of an inclusive growth or improvement in the well-being with the introduction of ICT. Thus IT can create a miracle in the unorganised manufacturing sector. This can also ensure the sustainability of the domestic demand for ICT.

V.CONCLUDING REMARKS

Thus our study shows that the dismal performance of Indian manufacturing sector can be improved by the successful implementation of ICT in the sector. The paper had pointed out the findings of the existing studies and compares it with the findings of the current result. The existing bottlenecks of the manufacturing sector can be removed by the introduction of ICT and other complementary inputs like various infrastructural facilities and government initiatives etc. As the Indian manufacturing sector is characterised by clear dominance of the unorganized segment, the scope of skill formation is extremely huge. This will not only formalize the sector but also ensure rise in productivity, employment and wage equality through skill formation.

References

Ahluwalia, I J. (1991), "TFPG in Manufacturing Industry." *Economic and Political Weekly*, Vol. 29: pp 2836.

Chandra, Pankaj, and Trilochan Sastry (2004), "Competitiveness of Indian Manufacturing: Findings of the 2001 National manufacturing Survey.", Working Paper No-2002-09-04, IIMA

CMIE , Industry: Financial Aggregate and Ratios, various issues

CMIE , National Income Statistics, various issues

Gangopadhyay, Shubhashish, Manisha Singh, and Nirvikar Singh (2008), *Waiting to Connect: Indian IT Revolution Bypasses the Domestic industry,* Lexis-Nexis-Butterworth, New York

Goldar, B N (1986), *Productivity Growth in Indian Industry,* Allied Publishers, New Delhi

Kathuria, Vinish, Rajesh Raj S Natarajan, and Kunal Sen (2010), "Organised versus unorganised Manufacturing Performance in the Post-Reform Period." MPRA Paper No 20317.

Kraemer, Kenneth, and Jason Dedrick (1999), "Information Technology and Productivity: Results and Policy implications of Cross-country Studies." *IT in Business,* CRITO, pp.1-47.

Little, Ian, Dipak Mazumdar, and John Page (1987), *Small Manufacturing Enterprises,* Oxford, New York.

Mazumdar, Dipak, and Sandip Sarkar (2008), "The employment Problem in India and the Phenomenon of the Missing Middle." Canadian Economic Conference, Vancouver.

Mitra, A.(1999) "Total Factor productivity growth and Technical efficiency in indian Industries." *Economic and political Weekly*, Vol.34(31): pp. M98-M105.

Mitra, Arup, Chandan Sharma, and Marie-Ange Veganzones-Varoudakis (2011), "Total Factor Productivity and Technical Efficiency of indian manufacturing: The role of Infrastructure and Information and Communication Technology." CERDI, Etudes et Documents E 2011.15.

NASSCOM (2010), NMCC-NASSCOM Report.

Panagariya, Arvind (2008), *India: The Emerging Giant.* Oxford University Press.

Sharma, Shruti, and Nirvikar Singh (2012), "Information Technology and Productivity in indian Manufacturing." Brookings-NCAER India Policy Forum

Trivedi, Pushpa, L Lakshmanan, Rajeev Jain, and Yogesh Kumar Gupta (2011), "Productivity, Efficiency, and Competitiveness of the indian Manufacturing Sector." DRG Studies Series No 37, Reserve Bank of India.

BANGIYA ARTHANITI PARISHAD
(BENGAL ECONO0MIC ASSOCIATION)
EXECUTIVE COMMITTEE: 2017-2020.

GUIDELINES FOR THE AUTHORS

1. All articles and notes submitted for publication must be in English, an abstract not more than 300 words should accompany all articles.
2. Articles published (or submitted for publication) elsewhere should not be sent. If the article has been presented in a Conference or Seminar, which should be indicated.
3. Authors should authenticate their writings by signing their full name and furnish their address. Institutions, if any, should be clearly stated. These details should be provided in a separate sheet and author's identity should not be disclosed either in the text or in the abstract.
4. Papers for publication should be sent in MS-WORD format (.doc or .docx file).
5. Matter, intended for footnotes should be indicated consecutively in the text by superscript numbers and it should be entered serially at the end of the manuscript.
6. Bibliographical references should be given in full, in alphabetical order, after the footnotes.
7. Quotations must be carefully checked and citations in the text must read thus (Hicks 1993). References in the bibliography should be in the form: Hicks, J.R. (1939): Value and Capital, followed by name of publisher and place of publication. Authors should adhere to Chicago Manual of Style/ APA citation style.
8. Tables, both in text or in appendices should be consecutively numbered using numerals on the top and appropriately titled. Sources and explanatory notes (if any) should be given below the table.
9. Mathematical expressions should be presented in a way that will be easily printable. Proofs of mathematical theorems should be furnished in full on a separate sheet, even if condensed in the text.
10. Diagrams should be clearly drawn in black ink on glossy white paper with all axes clearly positioned. The width of a diagram should not normally exceed 6 cm. The legend in respect of the diagram should be stated below the diagram. Diagrams should be inserted in the text with appropriate numbering and should be in compatible formats as BMP, JPG, JPEG, TIF, WMF or EPS.
11. Cite sentences or words taken from other works with single quotation marks; use double quotation marks only within quotations. Separate quotations exceeding fifty words from the text and indent them on the left. Unless the entire sentence is part of the quotation, the punctuation must remain outside the quotation marks.
12. Authors have latitude as regards italicisation, but italicisation needs to be consistent in the article. Both British and American spellings are acceptable but use should be consistent throughout the paper.
13. Write numerals between one and ninety-nine in words, and 100 and above in figures. However, the following are to be in figures only: distance: 3 km; age: 32 years old; percentage: 64 percent; century: 20th century; and years: 1990s.
14. Authors should supply art pools of their diagrams along with their articles.
15. All materials submitted for publication should be typed in double space and 2 additional copies should be provided for references. Manuscripts will not be returned to the author(s) unless referee suggests revision of the contents. Revised manuscripts must be submitted in the same form as the original.
16. The Editorial Board reserves the right to edit or to reject any material submitted for publication without assigning any reason to the author(s).

Sponsored by :

INDIAN COUNCIL OF SOCIAL SCIENCE RESEARCH

Vol. 27 , No. 4
Mach 2019 ARTHA BEEKSHAN RNI NO.53099/92

Published by Secretary, Bangiya Arthaniti Parishad, 87/277, Raja S. C. Mallick Road, Ganguly Bagan, Kolkata - 700 047.
Printed by Tamojit Bhattacharya, Kolkata Mudran, 12, Biplabi Pulin Das Street, Kolkata -700009, Phone: 9123018766, e-mail : tamojit.kolkatamudran@gmail.com