DO INCOME GROWTH AND TRADE EXPANSION REALLOCATE THE ECOLOGICAL FOOTPRINTS? A CASE STUDY OF PAKISTAN

MPhil Thesis

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CERTIFICATE

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Dedication

To the best woman in my life, my Mother, who could not achieve education from any formal institute but she became my first teacher when I was a kid. She never hit or scolded me for any of the mistakes I made in my life rather taught me through love, soft words, and advice. While narrating stories every night, she always used to tell me the moral of the story i.e., ‘He, who has a brave heart and is daring enough to face challenges, can make his ways to a happy future’.

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List of Abbreviations

ADF	Augmented Dickey Fuller
APFED	Asia-Pacific Forum for Environment and Development
ARDL	Auto Regressive Distributive Lag
EFC	Ecological Footprint of Consumption
EFP	Ecological Footprint of Production
EKC	Environmental Kuznets Curve
FY	Fiscal Year
GFN	Global Footprint Network
GHG	Greenhouse Gases
GWP	Global Warming Potential
Gha	Global hectares area
LCA	Life Cycle Assessment
LCE	Low Carbon Economy
PKR	Pakistani Rupee
PCA	Portland Cement Association
USD	United States Dollar
WDI	World Development Indicators
WWF	World Wild Life for Nature

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Abstract

This research aims to disaggregate the ecological footprints of Pakistan in relation to income growth and other explanatory variables, like trade openness bio-capacity and energy use. This study has also investigated the EKC type relation between income growth and environmental pressure, using secondary data for the period of 1980-2015 for Pakistan. This research has utilized the ARDL bound technique to determine short run and long run relation between income growth and per capita footprints for each economic activity separately. Research found that Pakistan is importing greater share of its total pollution from other economies over the time as the income increases. Consumption footprints are relocated by growing income of the Pakistan economy. As the income grows up, negative environmental consequences[1] are traded across the borders but inflow is quite higher than outflow in case of Pakistan.

Key words: Ecological Footprints, Income Growth, Trade Expansion. Bio capacity

[1] This term is commonly used for CO_2 emissions embodied in products, which are produced, consumed and traded across the borders, which are negative environmental consequences of our socio-economic activities.

CHAPTER: 1

INTRODUCTION

The economy of Pakistan has experienced momentous growth for the last few years. The key macroeconomic indicators have shown improvement in last three years. According to Pakistan Economic Survey (2016), the real GDP growth of Pakistan for the FY 2016 is 4.71, which is the highest in last eight years. However, the decline in growth rate of (0.19 percent) is recorded in agriculture sector. This is the highest decline recorded in last 14 years. Decline of cotton production has triggered negative growth of the sector. Industrial sector has grown significantly by 6.80 percent followed by the growth of 5.71 per in services sector for the FY 2016.

This indicates that economy of Pakistan has enhanced the Economic growth and Employment. In the time, when emerging economies are facing slow growth, Pakistan performed reasonably well in economic competition. The economy has achieved fiscal consolidation without compromising the developmental and social protection expenditures. Through effective expenditure management strategies and better revenue generation techniques, the economy of Pakistan has reduced the fiscal deficit from 8.2% to 4.3% in last three years. Per capita income of Pakistan has shown improvement from $1516.8 in FY 2015 to $1560.7 in FY 2016 [Economic Survey of Pakistan (2016)]. Increasing per capita income shows real GDP Per capita growth acceleration and slow growth of population. Economy of Pakistan is in developing phase. The development of any economy has certain environmental implications. According to National Plan (2012-13), Federal and Provincial Government of Pakistan have funded over 200 projects,

which are being implemented in environmental services for capacity building. These projects are based on provision of safe water facilities, risk management for Climatic changes and adaptations through Forestry, conserving the ecological infrastructure, Wildlife and Fisheries. These projects also includes sustainable urban management (Government of Pakistan, 2016).

The association between the "Economic growth" and Environmental distinction can be decoupled. According to Aldy et al. (2004) Economy has three sectors of development, Agricultural, Industrial and Services. Emissions increase in development of agriculture sector but these emissions are not intensive, as compared to the Industrial sector emissions of an economy. Development or transforming economy towards services sector, where services sector contribution to GDP is higher than other sectors. This will consequently reduce the environmental pressure on the existing bio-capacity. Now here we need to know, the way overall [2]Ecological Footprints and the [3]bio-capacity of a nation changes over time, as the economy passes through the stages of development. It refers to nonlinear relationship between income growth and environmental quality, over the long time. Changes in the structure and composition of international trade influence the global ecological patterns. In view of Hornborg (2001), the Ecological Footprints enable us to track the effect of income on national and international bio-capacity.[4] Current research

[2] "Ecological footprints measure land area required for production consumption and absorption of waste that is generated. It is an ecological accounting, which tell us the resource we have. And how much we are utilizing and keeping the records of resources regeneration as well".

[3] "The available bio productive space for nation, population or an activity, that's helps in providing natural resources to sustain the life. It is the ecological infrastructure which country has developed or has naturally".

[4]"Initially income growth adversely effects environmental quality, because of scale effect. After achieving the certain level of growth, the economy is able to install environmental friendly technologies in the production sectors, which safeguards the environmental quality. This is technical effect. The channel of composition effect can also affect the bio-capacity of the nation positively; when inputs-mix in the production process is changed from dirty to clean. This is also expected at higher income level countries"

has investigated that, whether income growth of Pakistan is reallocating the ecological footprints of the nation or not? Economies after certain limits of development often start caring about environment and increase expenditures on the environmental friendly technologies in the production process, which reduce the environmental impacts of the nation and thus reduce per capita ecological footprints. Aşıcı and Acar (2016) articulated a non-linear association of income growth and demand for environment quality.

This study is designed to quantify the resource use allocation through traded commodities, using the component and compound approach[5] calculations against income growth of Pakistan. To see how many clean and dirty products are imported and exported over time and answer the questions like: Is Pakistan going more resource hungry over time? Without confirming the bio capacity of the nation with changing economic activities, is just like flying an airplane without fuel gauge, which might be dangerous after some time to survive. This research has also focused the trade of bio capacity or biologically productive space through the imports and export of environmental friendly technologies and products across borders.

This implies that, if a nation is producing the same product with the use of high polluting inputs, or a combination of high contaminated inputs, which can cause high ecological footprints both on micro and macro level to any nation. From other perspective, use of high polluting inputs can restrict the bio capacity of nation.

Acar (2015). "This is how after achieving the growth stage, the demand for environmental quality increases and persuade in different ways. This situation is also known as Environmental Kuznets curve" (EKC)

[5] "This is a method for ecological footprints accounting. It is also known as bottom up method and top down method and the detail discussion on this term is given in chapter 5 in section 5.2.2 pages 36-37 last paragraph"

Also, the imports and exports of products, resonant to greater emissions and footprints are from top-to-bottom costly for the environment of receiving nations. It will be interesting to know how the economy reacts, when the income is growing and trade patterns are changing over time, in a developing country like Pakistan.

1.1 Research Questions

2 What is the trend of the Ecological Footprints of production, consumption and trade of major commodities over time from 1980 to 2014, in Pakistan?

3 Does trade flow effect CO_2 emission, Positively/Negatively, as a result of commodities trade?

4 Is there an EKC type relationship between Ecological Footprints of production, consumption and trade of selected trade commodities and income growth of Pakistan?

1.2 Objectives of the study

1) To decompose the Ecological Footprints of products into production, consumption and trade of major commodities over time, from 1980 to 2014 in Pakistan.
2) To determine the inflow/outflow of CO_2 emissions as a result of commodities trade
3) To investigate the EKC type, inverted U shape relationship for production, consumption of various goods and services and subsequent Ecological Footprints.

1.3 Significance of the study

This area has been studied through different empirical and descriptive methodologies over time in different countries, by different originations and researchers, but specific to product Ecological Footprints, are not yet considered against the income growth over time for Pakistan. This study specifically contributes to literature by decomposing and disaggregating the Ecological Footprints of selected products to determine the inflow and out flow of CO_2 emissions from trade in Pakistan. The investigation of Ecological Footprints reallocation against income growth is a policy oriented research to ensure the trade decisions of clean products for economic as well as environmental sustainability of Pakistan, through encouraging the better environment friendly technology in production process of products. Researchers around the world have used the EKC for single country cases for example (Burgess, Bedford, Hobson, Davies, & Harrison, 2003; Cole, 2000; Daly, 1993; De Bruyn, 2000; Lekakis, 2000; Stern & Common, 2001)].

The environmental changes against economic variations are extensively studied by (Iqbal et al., (2007); Shahbaz, Hye, Tiwari, & Leitão, (2013), Shahbaz, Solarin, Sbia, & Bibi, 2015). All these studies haven't confirmed yet the existence of EKC in individual country framework. But The studies byBello & Abimbola, (2010); De Groote et al., (2005); Shahbaz et al., (2015) have confirmed the existence of EKC in Pakistan. The current research has furthermore tested the existence of pollution heaven hypothesis (EKC). This is an exclusive case of ECO-footprints of selected commodities against income growth with some other explanatory variables for Pakistan.

1.4 Justification for Selected Products of the Study

The products, selected for the current research are Cement, Fertilizers, Cotton, Rice, Wheat, Meat, Petroleum Products, Plastic, polyesters, Papers and Fish. These are the major trading products in Pakistan [State Bank of Pakistan (2015)]. These products are selected on basis of per unit emissions. See Table 3.0, Table 3.1, 3.2, and Table 3.3 for more details. Significant space on the earth is required to support the production and consumption of these products over time. The importance of these products could also be seen, from the perspective of percent share in GDP and trade of Pakistan. Cotton has a significant share of 0.46 percent in GDP of Pakistan and 2.32 percent share in agriculture sector. The growth rate of cotton was 9.33 percent last year. But Cotton has declined by -27.83 percent this year [Economic survey of Pakistan (2015-16)].

Fishing is once again flourishing, by the record of 5.75 growth rates; fishing remained the second fast growing crop after cotton, in the agriculture category for the FY of 2014-15. In 2001 the composition of agriculture sector was comprised of 47.9 percent livestock, 47.6 percent crops, fishing was 1.7 percent and forestry remained 2.8 percent. But today the agriculture composition has changed. The share of livestock has increased, which is currently 58.6 percent. On the other hand, the share of crops has reduced to 37.2 percent. The change in composition of sectors reallocates the emissions of sectors and thus ecological footprints of economy. Current study has selected these products to track the effects of income growth on variations in demand and trade pattern of these products and consequently, imposed pressure on bio productive space of Pakistan.

1.5 Hypotheses of the study[6]

H1: “Growth of GDP per capita and trade expansion has no significant impact on Ecological Footprints of consumption”;

H2: “Growth of GDP per capita and trade expansion has no significant impact on Ecological Footprints of production”;

H3: “Growth of GDP per capita growth and trade expansion have no impact on Ecological Footprints of Exports and Imports”

1.6 Plan of the study

The study is divided into 7 chapters. Chapter one is introduction of the study. Chapter two presents the thematic reviews of literature. Chapter three explains the trade pattern and ecological foot prints of Pakistan. In chapter four, data trends and theoretical framework is discussed, while fifth chapter consists of data and methodology. The sixth chapter presents the results and discussion of the study. The last chapter seven concludes the thesis, followed by policy suggestions.

[6] These are the null hypothesis,

CHAPTER: 2

LITERATURE REVIEW

2.1 Introduction

The chapter is organized, in four subsections, as starting from the discussion of Pakistan income growth and emissions, in section 2.2, followed by the debate of trade, EKC in section 2.3. The next section 2.4 discusses Ecological Footprints of consumption and production. Section 2.5 explains the ecological footprints of trade across borders and the last section of this chapter is 2.6, which summarize the whole chapter.

2.2 Income growth and Emissions

Looking back in 1980s the Economy of Pakistan was serving to 96 million population Economic Survey of Pakistan (1991-92), now this economy is providing, food, shelter, and infrastructure and defence services to 195.5 million people. In 90s the literacy rate was 29.5 percent and today it is 60 percent [Pakistan Economic Survey (2015)]. Economic indicators of Pakistan have portrayed a very active image of continuous growth throughout the history. Per capita Income growth has shown significant growth of 9.25 percent in dollars' term and 7.5 percent growth in rupees' term for the FY (2014-15) as compared to 3.83 percent in rupees' term for the FY (2016). According to Pakistan Economic Survey (2016), per capita income was 746 USD in FY 2000, which declined to 663 USD in 2003. After 2003 per capita reached to 1053 USD in FY 2007, it has reached to $1,512 in 2014-15 and increased to $1,560 in 2016. Mehmood and Shahab (2014) argued that industrializing and economic growth over the time has drifted the emissions of Pakistan positively from 1990s. Per capita emissions of Pakistan were 0.41 metric tons in 1980s, which reached 0.63 metric tons per person in 1990s and to 0.96 metric tons per

person in 2010. For sustainable development, Pakistan is facing critical challenges of current time, to manage the GHGs emissions at optimal level and increasing economic growth. By doing the county wise analysis of PIC nations (Pakistan, India and china) Irfan, Usman, and Kusakabe (2011) have done a decomposition analysis. The argument of their contribution was that, effect of CO^2 emissions and atmospheric emissions in Low Carbon Economy (LCE) is a reality, which cannot be denied. (Muhammad & Ghulam Fatima, 2013) found that [7]financial development and energy consumption are the most important factors of carbon emissions in Pakistan. The only solution to environmental problem, like global warming, is to lower the carbon emissions through better technologies deployment and special attention to reduce the emissions from high emitting sectors.

Mehmood and Shahab (2014) argued that in the case of Pakistan, high use of petroleum, to meet the transport sector demand is a most important reason, accounted for high CO^2 emissions. The highest share of CO^2 emissions is produced by production and transport sector. The coal consumption is causing a significant amount of CO^2 emissions. In FY 1999 the brick production sector was using 89 % of coal as compared to 37 % in 2011. Today the trend of construction style has changed resulting in frequent cement use in housing and other infrastructure development. The increasing demand for coal in cement sector has shown 61 % use of coal in FY 2011 as compared to 0 % coal used by cement sector in 1990s. Over time Pakistan has faced negative environmental consequences of the industrial revolution. The industrial-led growth has increased the energy demand and

[7] Financial development indicates the private credits as percentage of GDP, which increasing per capita energy use, by encouraging consumer's purchasing power in short run. This type of assistance, often encourage consumers to buy electric appliances and thus increase overall the GHG emissions of the country.

thus, the environmental pollutions in the country. The industrial sector of Pakistan consumed 36% and transportation sector consumed about 33% of total energy whereas the overall consumption of industrial sector increased to 43% in 2010 (Shahbaz & Lean, 2012). The concentration of greenhouse gases like, carbon dioxide (CO2) has increased to 35% since 1870 to 2000 but after 2001, the world has faced strong awareness and many countries have done strict enforcement of laws and acts to reduce the emissions to the certain limits for the public and ecological happiness (Attari, Kamal, & Attaria, 2011). Citing the Clean Development Mechanism channels, the Kyoto Protocol, has implemented the rule of accomplishing the ecological obligations, for the rich counties and other working industries in any nation. This is a process when the demand for environmental quality is higher. This can be only done, if rich countries of world started to progress some diverse and sustainable projects for development to bring down the level of CO^2 emissions in low income counties [Hu, (2002)].

2.3 Trade and Environmental Kuznets Curve (EKC)

Environmental Kuznets curve is studied more frequently in background of Trade, which are the indications of increasing Economic prosperity. Economic Development increases pollution through creation of higher output, but then again several economists have discussed, that trade may not be the elementary foundation source of environmental damages (Birdsall & Wheeler, 1993; Lee & Roland-Holst, 1997). Economists like Jones and Manuelli (1995) argued that unrestricted trade has unpredictable effect on environment. It can be in ways, increasing pollution on the one hand and on the other hand appealing for the reduction of emissions through the development and exchange of environment friendly technologies. Makki and Somwaru (2004) found that the export

growth intensifications lead to high factor productivity. It is due to advantages gained from increasing returns to scale. Increases in productivity, now the exporters are more economically capable to join the foreign markets for trading, which help us to develop technology and it provide headway to indigenous industrialists for exposure. It indicates a possibility of producing goods domestically with better technology and less emissions. In addition, more significantly and global trade can also create a possibility of importing goods rather than producing locally, which are environmentally caustic to bio-capacity of an economy. Let’s say, a nation is manufacturing a product for export, the negative environmental consequence or embodied Footprint of this product will not be the part of that country's consumption Footprints; somewhat, it will be counted in the Footprint of consumption of the country, which is going to import the product and uses it in the production of other products. However, these embodied Footprints will be counted in the production footprints of the nation, which is exporting (Borucke et al., 2013).

Environmental Kuznets curve exists for environmental those influences, where a conversion is predictable on very critical point. On one side, the turning point of Inverted-U-shaped relationship can fluctuate accordingly for different impurities and Environmental quality could be deteriorated over and done with scale effect, which means increasing trade volume (particularly exports), which is intensifications of higher contamination. On the other hand, trade can help to recover the quality of environment through changing inputs composition in production to cleaner inputs, which composition effect or technique effect as mentioned earlier. The technical improvements, that provides pollution reducing innovation.

Among these effects composition effect is better to understand the Displacement Hypothesis and Pollution Haven Hypothesis. The economics of international trade associates composition effect with the theory of comparative advantage, where a developing country can be linked with developed countries, for the purpose, that they can trade for better environmental friendly technologies to reduce the future environmental pressure. Consequently, single effort to encourage eco-friendly impressions may amplify some additional complications (Suri & Chapman, 1998).

Many studies are focused on multi-countries stories. In fact, "EKC hypothesis is basically a within-country story, but cross-countries analysis are based on the assumption, that all the cross-sections nations respond identically no matter how different their income, geographical circumstances, are (Dijkgraaf & Vollebergh, 1998). Lopez and Mitra (2004) included the variable corruption as well to standard EKC framework, but income level and environment were focused by many authors like, (Birdsall & Wheeler, 1993; Shahbaz et al., 2013; Shahbaz et al., 2015; Stern, 2004).

2.3.1 History of Environmental Kuznets Curve

The environmental degradations have a tendency to increase with income growth in early stages but after reaching to an optimum level, the pollution starts decreasing. This implies that higher income countries care about environment after some level of loss to environment and developed nations are contributing less to environmental degradations. Therefore, some economists argued that the increasing income is the natural solution for reducing pollution and natural resource depletions. The relationship between change in income level and environmental quality was termed, the Environmental Kuznets Curve (EKC). This Inverted-U shaped relationship was originated from the efforts of Kuznets

(1955). The basic reasoning of Environmental Kuznets Curve existence is subconsciously appealing; stating that in earlier phase of development pollution is increasingly produced because of high priority given to the intensification of material for growth of output with less concern about environmental quality. Dasgupta, Laplante, Wang, and Wheeler (2002) also argued that faster growth is unavoidably resulting in greater use of natural resources and do result in the emission of pollutants, which is causing substantial stress on the quality of existing environment. In later stages of development, as the level of income increases, the worth of environment is realized and controlling organizations turn out to be more operative and the level of pollution declines.

Accordingly, the (EKC) hypothesis, which postulates the response of human's behavior over time to environmental concerns with different level of income. In EKC framework many studies are focused on one-dimension environmental quality indicators. Mostly, effects of income on environment are considered in both countries, where the products are produced and consumed. Yet, it is clear that the effects of economic activities on environmental quality are multi-dimensional rather than one-dimensional. So the place of production matter a lot for future bio capacity and also the bio productive space of the place where consumption of the product is expected, can be effected if the product is not produced in environmental friendly process. Panayotou (1993) stated that over time at least economic growth is constructive for better environment, when it encourages the ideas of environmental quality after some level of economic growth. Based on this argument the present study has investigated the EKC type relation between income growth Trade and ecological footprints.

2.4 Footprint of Production and Consumption

The production footprints of a product can be calculated as the summation of all resources utilized for the product of that specific commodity. These resources are harvested for energy purpose, which is needed for the product, these resources are harvested for building up the infrastructure and are generated within the geographical area of the nation for which the calculations are made. The direct demand for local or domestic biological productive space can be estimated from the production footprints directly, as well as the executed demand is designated by indigenous CO^2 emissions.

All The area required for the production, harvesting and processing of products from cropland, pasture lands forest lands and water bodies is included in the production footprints account of a product. Other than this the forest area or land area which can absorb all the carbon dioxide emissions cause by burning the fossil fuel, within the boundaries of the products producing country. A specific portion of these production footprints are exported to other countries in form of trading commodities. To calculate the furthermost frequently described kind of Ecological Footprint one should use the production footprints subtract the export footprints and plus the import footprints. Imports are counted as part of same type of footprints and That is called the consumption footprints (Borucke et al., 2013). One of the research in 2007 reported that, Portland cement Association (PCA) members estimated an average of around 927 kg of $CO^{2,}$ which are regularly emitted for every 1000 kg of cement production in the U.S (Marceau & VanGeem, 2007). The ecological footprints of one activity might be effected due other activity as these are interlinked together.

2.5 Trade Ecological footprints

Ecological Footprint account includes the Footprint that is embodied in commodities, traded across borders. The products are imported and exported within embodied CO^2. This is how, the ecological footprints are traded in form of a material commodity (Borucke et al., 2013; Alessandro Galli, Weinzettel, Cranston, & Ercin, 2013). The exports are subtracted from the production and imports are submitted within the consumption footprints, while calculating on a nation level. Economic activity is inevitably dangerous for ecologically disturbing in some way. Sustaining the needs of individuals entails use of energy flows and materials and can also disturb the flow sometimes (Stöglehner, 2003).

Aşıcı & Acar, 2016) argued that trading cleaner inputs for the production process can save local bio-capacity for future. The products, which are highly resource hungry should be imported from other economies on viable economic transactions. This is also called trading biological space. The imports of dirty products reduce the production emissions of a country and so effects the ecological footprints of nation accordingly. Looking to the other dimensions of trade and ecological footprints, trade is also source to join the advance and developed world markets for the transfer of cleaner technologies. This can reduce environmental pressure of community through technical effect for details see, chapter no 3

2.6 Summary of Literature Review

Studies like, (Ahmed, Butt, Alam, & Kazmi, 2000; Bahmani-Oskooee, 1993; Balassa, 1985; Feder, 1983; Ghafoor, 2002; N. Iqbal & Ghani, 2014; A. H. Khan, Malik, Hasan, & Tahir, 1995; M. Khan, 1971; Zaidi, 2000) have studied exports, imports, and economic growth of Pakistan with different methodologies, using long run Cointegrating analysis and short run panel analyses, which show positive relationship between income growth and exports, supporting the export led growth hypothesis.

The studies like Shirazi and Manap (2005) and the data of world bank (2014), reported increasing trend in exports and imports over time but the investigation of N. Iqbal and Ghani (2014) argued that, imports share of consumer goods declined until 2008 and then started rising trend again tell 2012. I have also included the studies of (Birdsall & Wheeler, 1993; Borucke et al., 2013; Dasgupta et al., 2002; De Bruyn, 1997; Kuznets, 1955; Panayotou, 1993; Shahbaz et al., 2015; Suri & Chapman, 1998) specifically on Trade, EKC, Eco footprints and income growth relationships, where different methods and views lead the discussion to investigate more.

(Balassa, 1985); Feder (1983) examined the role of exports in growth of economy as well as trade and industry progress. Using Panel data, the studies found the Promising influences of exports on economic growth in developing economies. A. H. Khan and Saqib (1993) and Shirazi and Manap (2005) found strong indications of bi-directional causation between export growth and economic growth in Pakistan. These authors have used the time series data and applied simultaneous equation model to test the robustness of the relationship amongst trade performance and economic growth in Pakistan.

Similarly Ahmed et al. (2000); Naeem (2009) investigated the relationship between exports, economic growth and foreign debt for Bangladesh, India, Pakistan, Sri Lanka and four South East Asian countries. The income growth effects efficiency of production and industrialization, which can push the economy towards specialization, consequently reduce the imports footprints and can produce in home country. Also through production specialization producers can produce at low cost and face higher demand through trading at low prices.

This way the negative consequences are exported to other nations and the home environment is ecologically protected on the cost of global environment. The current study has decomposed the analysis of income and environment association by taking selected traded commodities specific footprints standards, to investigate the reallocation of ecological footprints through the income growth and trade expansion over time. Researchers have used EKC and recommended, to test the EKC hypothesis for an individual country (Cole, 2000 De Bruyn, 2000 Lekakis, 2000; Stern & Common, 2001). Current study has studied (Economy) ecological economics of Pakistan by terms of footprints and economic indicators, like income growth and trade expansion.

CHAPTER: 3

TRADE PATTERN AND ECOLOGICAL FOOTPRINTS

3.1 Ecological Footprints

According to Global Footprint Network (2013) “Ecological Footprint is a measure of, how much biologically productive land and water an individual, population or activity requires, to grip the waste it creates, using usual technology and resource management practices”. The commonly used measurement unit for ecological footprints is global hectares. Economic and Environmental Sustainability is the key challenge of time. It is very important for growing and strong economies, because it’s the only way that makes us sure to survive in future. According to (Borucke et al., 2013) the sustainability framework recommends three important things to integrate in our lifestyle. The first is to increase the use efficiency of resources we consume, second is to protect and restore natural assets and finally to minimize our daily environmental impacts. This is how, the ecological foot print tool becomes very useful.

The Ecological Footprints help us to evaluate the impacts and demands we are placing on our natural resources and environment (Aşıcı & Acar, 2016). Humans are the most successful species on this plant. Nobody could have imagined 200 years ago the life; we are living today. We have been able to create a wide range of technologies and the construction of cities to live with. It is quite plausible to think that, how the humans will be successful to maintain the success in future. Ecological Footprint is tool like a bank statement, which measure, how much of resources, we have that renew itself and how often do we use them?

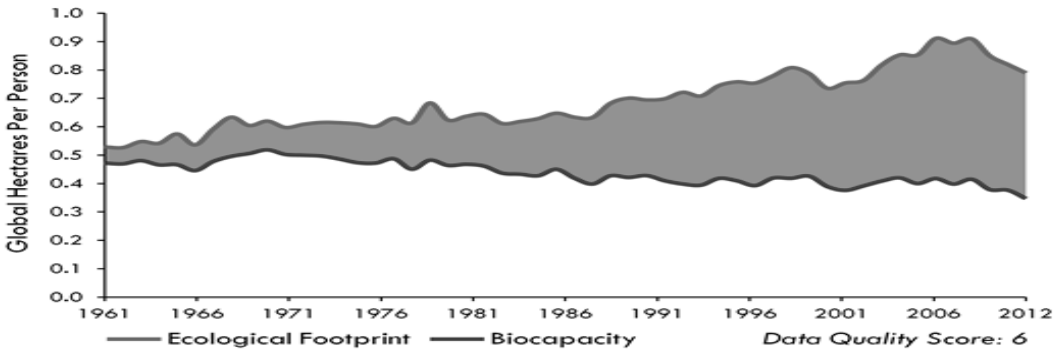
How much resource in terms of bio productive space we have to support the consumption and production, in the economy and to absorb the waste of these activities? That what the Ecological Footprint measures. The resources are converted into the wastes which are renewed back to resource power by Sun, again to waste and again to resource. (A Galli et al., 2007) argued that this is life cycle process. The global supply side is roughly 1.8 hectares' per capita biological productive space, which is the possible budget that nature has provided. Development tracks the creation of new technologies that is ingathering these resources more rapidly. The demand side indicates world average of 2.2 hectares per person. Increasing population and energy use have increased the demand of natural resources in past decades around the world as well as in Pakistan.

According to Wackernagel, Monfreda, Erb, Haberl, and Schulz (2004) the reduction of ecological bio productive space for other species is cause of human dominancy in ecosystem of the Earth. According to Global Footprint Network (2008), the existing universal depletion of resources is around 50% beyond the known biological capacity of the Earth. Among 199 nations unfortunately just 60 countries are in surplus having carrying-capacity. It means 139 countries have gone beyond the use limits of natural space (Network, 2008). According to World Wild Fund for Nature (2012), it is plausible to think that the available bio capacity can also affect the production, imports and income relationships in home country. It is highly threatening for resources in those countries, where the income growth lead to higher resources extraction and progressive resource uses and follow-on by the large amount of pollution on the expectations of higher absorption capacity of home lands (Bagliani, Bravo, & Dalmazzone, 2008).

Huang & Wang, (2013), Rivera & Oh, (2013) argued that a country, which has clearly defined the environmental regulations, is more preferred for foreign direct investment and international trade. Before that Lovely and Popp (2011) specified the expenditure on controlling of pollution or the abatement cost, can significantly affect the trade pattern of a nation. Sustainable development has to be promoted and have to be on middle-of-the-road. One of the leading organizations, working for environment in Islamabad has taken an incentive named as "Greening Organizations to Reduce Ecological Footprints". The organization is working on introducing institute with ecological footprints technologies. [LEAD: Pakistan (2009)]. In 2010 Pakistan had 173.18 million of population and 0.77 foot prints per person, while having 0.43 bio-capacities less than ecological footprints. It means that, Pakistan is an Ecological deficit country by -0.34 global hectares, per person. Just few years back the statistics of such indicators were quite different as given bellow, we are too fast and highly dependent on nature [Global Footprint Network, (2010)].

After 2 years, the per capita ecological footprint of Pakistan increased to 0.8 while the bio capacity was 0.4 per capita global hectors [Global Footprint Network (2012)].

Figure 3.1 Pakistan's Eco Footprints and Bio capacity 1961-2012[8]



[8] This is data of GFN, while graphs and table regarding the same variables are given in chapter 6, which is the results chapter of current study

Figure 1 provides a pathway of per person resource demand also known as (Ecological Footprint) and per person resource supply also known as (Bio capacity) in Pakistan over a period of 42 years. Carrying-capacity fluctuates every year with management of national environment, ecology and farming practices, like: fertilizer use, irrigation type and also the trade across borders for technological developments. The upper line is indicating the ecological footprints, which is showing increasing trend, while the line below is the bio-capacity of the Pakistan, exhibiting declining trend. The amount of the greenhouse gases released into the atmosphere during the production and consumption process directly influence the ecological footprints. To remove greenhouse gases from the environment, more sea and forest areas are required. (Wright, Kemp, & Williams, 2011).

It's critically important for a nation to keep the records of their ecological capacity and ecological footprints to sustain in the future. The accounting of ecological footprint with reference to trade is likely to be more policy-oriented analysis for trading clean products across borders to sustain ecological bio capacity of the nation. Table 3.1 shows per unit standards of carbon footprints and the ecological footprints of the listed products.[9] Using country and product specific standards of ecological footprints, with reference to the origin of imports to Pakistan, the investigator has used these following standards, for the composition of dependent variable, Ecological footprints of Pakistan through a disaggregated analysis.

The products, which standards are not yet developed by some countries, here we, have used the standards of adjacent countries or identical income class countries for Ecological

[9]These product specific standards are used to calculate the total emissions of production, consumption and traded goods across the nations.

Footprints calculations. Carbon yield uptake capacity is 1.8global averages, which is required to convert the CO2 emissions to Gha units of ecological footprints. Lee and Peng (2014)

Table 3.1 Descriptive data of per unit CO2 and Ecological Footprints of products selected for the study

Year	Product Quantity (KG)	CO2 in (KG)	Ecological Footprints (Gha)	Country	Method	Source/references
1998	Cement 1000 Kg	1200	0.52	India	LCA	Malhotra (1998)
1993	Cement 1000 Kg	1250	0.55	India	LCA	Wilson Alex (1993)
2005	Cement 1000 Kg	927	0.37	USA:	LCA	Marceau, Medgar (2005)
2005	Cement 1000 Kg	900-1100	0.65-0.85	USA Portland	LCA	Environmental Protection, Agency (2005)
2010	Cement 1000 Kg	1500	0.39	Pakistan	LCA	World Development Indicators (2010)
2000	Cotton 1000 kg	2120	1.03	USA	LCA	LillemorLewan (2000)
2000	Cotton 1000 kg	3500	1.85	India Panjab	LCA	LillemorLewan (2000)
1999	Polyester1000 kg	1670	1.67	UK	LCA	Soth, J (1999).
1999	Plastic 1000 kg	2200	2.21	India Panjab	LCA	Soth, J (1999).
2005	Meat/lamb 1000kg	39200	21.63	Asia	LCA	Env- working group 2005 AFA
2005	Meat/beef 1000 kg	27000	14.86	Asia	LCA	Env- working group 2005 AFA
2013	Wheat 1000 kg	3400	1.5	Asia	LCA	FAO FWF, (2013)
2013	Wheat 1000 kg	2000	0.97	Europe	LCA	FAO FWF, (2013)

2013	Rice 1000 kg	5000	2.63	Asia	LCA	FAO FWF, (2013)
2012	Rice 1000 kg	2700	1.36	Pakistan	LCA	WWF (2012)
2012	Fish 1000 kg	11009	5.97	Pakistan	LCA	AFP (2012)
2013	Fertilizers	4600	3.6	Middle income	LCA	YARA (2013)
2011	Fertilizers	1950	1.8	European Union	PRD	European commission (2011)
0000	Sequestration	1400	1.4 Co2/ per 1 Gha	Uk	Forest	UK Forest, Ministry

The standards of per ton emissions of Fish, Meat, Wheat and Rice for mentioned countries are converted to Gha by author; these are calculated through Lee and Peng (2014) formula of CO_2 conversion with yield factors.

$$Carbon\ footprint\ (gha)\ =\ CO2\ emissions\ (tons)\ \times\ (1\ -\ 1/4)/1.8$$

This is Uk standard but for final estimation as mentioned in methodology, the data is processed country specific standards and conversions factor components. There are some other standards like: the conversion factor for land area sequestration for one tonne of CO_2 in hectares is (0.19) and global hectare equivalence factor is (1.17), previously used by Nicola Hogan in University of Limerick's (2014).

The study has also utilized these standards to estimate the imports ecological footprints. Where the conversion from CO_2 to land acers needed to engross it, which has done through this formula in Excel: = (CO_2 tons*0.19) and to-covert from acers to Global hectares, the study has utilized the formula = (100 acers*1.4).

Table 3.2 shows carbon footprints per KG of K and P fertilizers. According to Taylor (2008) and Rivera and Oh (2013) trade, investment, ecological footprints and economic wellbeing are influenced by the environmental regulations and income growth.

Conversely, the combination of inputs has influenced the emissions. The composition has changed from nitrogen oxides to carbon dioxide. The world average is 0.45 kg/per kg triples super phosphate fertilizer, while the adjacent countries to Pakistan for example china and India have the highest $C0_2$ emissions of 0.59 kg/ per kg fertilizer production. For Potassium chloride, these countries have 0.91 kg CO_2 emissions on per kg of fertilizer while other economies are around about 0.60.

[10] Table 3.2: Estimated Carbon Footprint for P-and K Fertilizer (In Kg CO_2 eq/Per Kg P2O5 or K2O

Regions around the globe	Triple Super Phosphate	Single Super Phosphate	Ground rock	Potassium chloride	Potassium sulphate
	Per kg P_2O_5	Per kg P_2O_5	Per kg P_2O_5	Per kg K_2O	Per kg K_2O
World's average	0.44	0.16	0.23	0.69	0.23
Western Europe	0.36	0.13	0.19	0.56	0.19
; Russia and central Europe	0.45	0.16	0.23	0.68	0.23
North America	0.36	0.13	0.18	0.56	0.19
China + India	0.59	0.21	0.31	0.91	0.31

Source: A. Kool M. MarinussenBlonk (2012)

Table 3.3 shows the Global warming potential (GWP) of CO_2, CH_4, N_2O and some other given Green House Gase$_s$, which is the degree of heat trapped in the atmosphere due to a green-house gas. The variation of emissions to GWP is observed from stage to stage for each GHG listed below. GWP is considered over a precise interval of time. This is also

[10]These standards are helpful for the estimation of fertilizers ecological footprints, traded across the borders.

expressed important factor, greenhouse gases like, CO_2. Which GWP is commonly standardized from 0 to 1, (Guo, 2013; Stocker et al., 2013).

Table 3.3 Structuring of a Category Indicator Result (GWP100) Against Life Cycle Stages, Expressed As a Percentage

GWP_{100} from	Materials production %	Manufacturing processes %	Use phases %	Others %	Total GWP %
CO_2	5.8	2	20.9	2.3	31.9
CO	0.3	1.1	1.7	0.3	3.4
CH_4	8.7	0.6	1.2	1.8	12.3
N_2O	17.4	1.2	1.8	0.6	21
CF_4	22.1	2.9	—	—	25.0
Others	2.4	1.7	1.4	0.9	6.4
Total	56.7	10.4	27	5.9	100

Source: (US. EIA 2011)

3.2 Economy of Pakistan

According Finance division of Pakistan, the economy has shown the significant growth of 12.8 percent in gas and electricity supply and 13 percent growth in construction activities. The economy is developing by Industrial Growth of 6.6 %, recorded for the FY 2016. Pakistan is one of the fast-growing economies in the region, with 4.71 percent real GDP growth but carrying per capita ecological deficit of -0.339 Gha, which means Pakistan is still a resource hungry economy by 33 percent as of its own generated resources around the year [GFN (2010), (2012), and (2014)]. Ecological deficit is not only a term of Environmental accounting, but a serious issue of resource utilization ratio and available capacity for a nation, which in case of Pakistan is above the available bio capacity. In very near future, this will be the biggest worry of wise professionals on the

Planet. Economist category is one of the responsible groups, to manage the resource flow across the borders. Sustainability of resources and biological productive space for Pakistan is quite challenging due to the use of resources beyond the available capacity. But Aşıcı & Acar, (2016) argued that the ecological deficits can be recovered by either importing or exporting the biological capacity across borders. Their investigation was based on cross sectional observations for more than 100 countries, and additionally important, Acar (2015) detected, that as the economy get richer, the countries are exporting products embodied emissions and have uncovered some of the factors that drive such behaviour. This modern-day investigation is a disaggregated analysis of income growth and ecological footprints nexus. This is a single nation story of Pakistan. Moreover, the development of the economy, change in demand and trade patterns of Pakistan is reallocating the resources use and bio capacity of the nation over time. That's why climate change, deforestation, clean water shortage, pollution and biodiversity loss are top listed issues of environment in Pakistan [Government of Pakistan (2016) Chapter (16)].

3.3 Trade Pattern and Ecological Footprints of Pakistan

During the early stages the potential of accessible resources were not employed in more effective and sustainable ways, which indirectly abridged the growth of the economy. In 1948-49, 99% of Pakistani exports were primary commodities like raw jute, raw cotton, raw wool, hides and tea. In 1950, the exports of Pakistan declined by means of 43.18 percent and received RS, 1343 million on account of exports. The economy was trading higher volume of primary good as compared to semi manufactured and manufactured goods. In 1960-61 Pakistan's exports were documented as Rs.540 million, improved the

drive for the period of 1960s exports enhanced by 161.88 % [Ghafoor, (2002)]. The exports of Pakistan have notably improved from Rs 1998 million to Rs 29280 million in the decade of 1970s and progressed to Rs. 138280 million in 1990-91 (Zaidi, 2000). After 2001 the share of primary commodities was increasing. In (2001) it was 13 percent but in FY (2016) it has reached to 17 per cent [Economic survey of Pakistan (2002-03)] According to Kemal, et al (2002), which can also have interpretation, which are plausible to economic, and may also be seen or understood very important for policy. In past decade, the highest share of primary goods in exports was 18 % in the FY (2010-11). While in FY (2015) the share of semi manufacturing goods was 17 per cent. Most probably, it was the highest contributions of semi manufacturing goods in last decade. The most significant exports of Pakistan are manufactured goods, which has constantly above 70 % share of total exports from last 15 years. However, the overall contribution of manufactured goods in the exports of Pakistan is decreasing over time [Pakistan Economic survey (2015-16)]. Pakistan was exporting few items like, cotton, leather, rice, and synthetic textiles and sports goods. The exports share of these items was around 80% in (2004-05). Among all the listed exports products, only cotton was contributing approximately 62.5 percent trailed by the exports of leather products about 5.3%, rice products were 5.2%, synthetic textile 4.2% and sports goods 2.6. Pakistan trade with multiple countries at the same time, there were limited trading products. Only because of specific trading agreements with other trading partners, economy of Pakistan has not been able to import from its own regional trading partners. This can restrict the economy from developing the infrastructure and other facilities interlinked to the trade (N. Iqbal & Ghani, 2014).

Table 3.4 Changing Patterns of Exports

COUNTRIES	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010
Netherland	1.84	3.17	3.05	2.60	2.45
France	3.42	3.88	3.07	2.70	1.88
Italy	7.16	4.83	2.7	3.22	3.50
South Korea	3.18	3.05	2.61	2.15	1.16
India	4.90	0.992	0.962	0.90	1.65
Total	20.5	15.922	12.392	11.57	10.64

Source: (Iqbal & Ghani, 2014) Percentage Is Unite

The trade pattern of Pakistan with reference to trading partners has undoubtedly changed over the time. There are several logical explanations for the reallocation of exports, which might be the population increase, war, home country demand and the factors of supply side [Nasir et al (2014)]. Also the trade agreements, exchange rate fluctuations, tariffs, duties and environmental regulations of the receiving nations are possible reasons for changing composition of exports and quantity fluctuations (Rodden, Eskeland, & Litvack, 2002).Pakistan exports have declined to 185754 PKR Million in January 2015 from 187086 PKR Millions. Exports in Pakistan are averaged around 36498.90 PKR Million since 1957 until 2016. The Highest accomplishment in all-time, of 275483 PKR Million in 2013 and a record of lowest 51 PKR Million in 1958 are on the records. This shows significant growth in the exports of Pakistan over the time (Shirazi & Manap, 2005).

According to (Rehman, Ilyas, Alam, & Akram, 2011) the concept of trade openness from the theories of Adam Smith and David Ricardo, International Trade, and international development, Where the Economic gains of specialization are the cause of skills, technology, and well enhanced exports of a nation. A debate, that export growth intensifications can lead to high yield of production due to advantages gained from increasing returns to scale in the international trading markets. This will result in technological developments and progression of local industrialists (Makki & Somwaru, 2004).

3.3.1 Imports of Pakistan over time

Major trading partners and markets for Pakistan are Saudi Arabia, Kuwait, Japan, US, Germany, and UK. The value of Pakistan imports products has increased by 12.8% in FY 1972 to 20.3 percent in FY 2012 [World Bank, (2014)]. But comparatively this value is still very low. Average growth rate of imports to the GDP ratio was around 1.4 percent. On the other hand, the imports of India increased from 3.6 percent in 1971 to 31.5 percent in FY 2011. Same growth trend was seen in Bangladesh, where the imports of economy were increased from 8.1 percent in FY 1971 to 32.2 percent in FY 2011. They have shown an average growth rate of 7.1 percent every year. Other neighbouring economies like, Sri Lanka has increased their imports from 23.9 percent of GDP in FY 1971 to 36.5% in FY 2011 [World Bank (2014)].

In FY 2012, third quarter of its total imports were including the machinery of (14.5%), energy products eg: petroleum products were (34%), chemicals were (13.6%), edible oils (5.4%), iron and steel (3.9%), and fertilizer (2.8%). According to Iqbal et al (2014), a similar pattern has been observed over the last decade. The decline of around 5% was

observed in imports of capital good from 1975 to 2012. Around 30% capital goods were imported from 1980 to 2005. This ration remained the same for given period of time but Share of inputs and raw material used within consumer goods was highly improved from 39.5 percent in 1975 to 56.1 percent in FY 2012. The share of consumer goods readjusted after the 10% in 2008 to 2012 (N. Iqbal & Ghani, 2014). Under its free trade agreement with China 2007, various products manufactured in Pakistan are allowed access to Chinese markets at zero duty. The trade agreement with China has certainly positively affected the imports from China. Pakistan increased the imports from China, which accounts around 12% of its total imports in FY 2013 compared to 5.6 percent of total imports in FY 2002 [State Bank of Pakistan (2014)].

Currently Pakistan is importing Chemicals, fertilizers, drugs, petroleum products and machinery as major imports [Pakistan bureau of statistics (2016)]. The imports of Pakistan have increased with high rate over the time, where the question is, "Are we moving towards cleaner products by changing the composition of imports and exports over time"? Now it's a subject of better devotion, to look after, the way we are of moving the needle to cure the existing Environmental damages.

Table 3.5 Percentage Share of Pakistan imports in GDP

Type of Products	2000-2004	2005-2007	2008-2010	2011-2013
Agriculture	5.24	4.31	4.70	4.56
Fuel	24.54	24.50	30.61	33.66
Machinery and transport	55.95	54.42	56.52	46.46
Food	11.33	9.96	12.1	12.06
Metal	2.69	3.40	3.24	2.786

Source: World Bank (calculated by author)

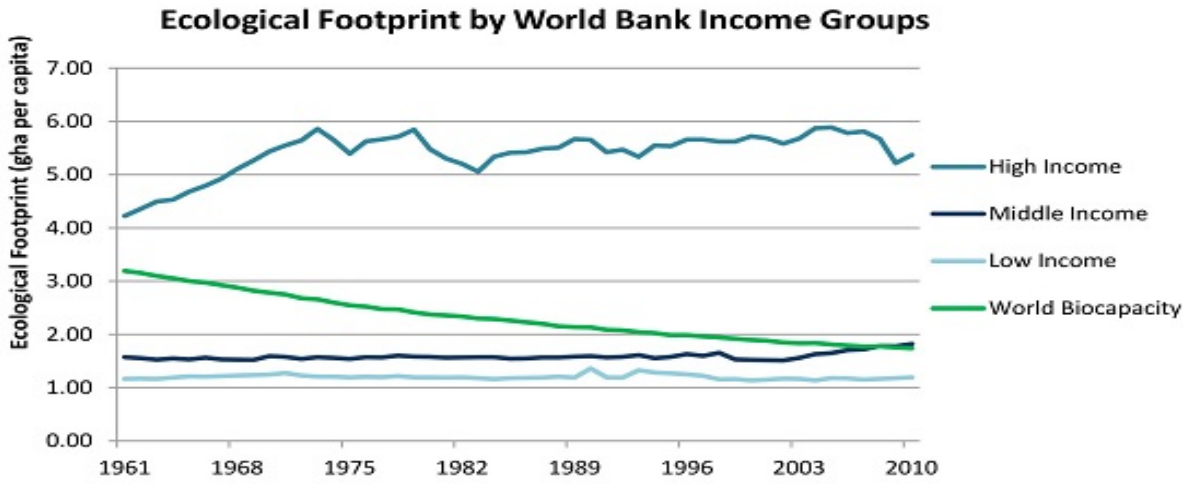
3.3.2 Trade, Ecological Footprints and biocapacity

According to (Andersson & Lindroth, 2001) the relationship of trade and environment is multidimensional. There are several ways that could possibly reallocate the ecological footprints of a nation. Positive allocation effect of trade is which enable the economy to specialize on products to produce it more efficiently on minimum resources. The second thing, trade can cause to negative income effects. Negative income effect is a situation, when economy income is enhanced due to trade, which increases the consumption of economy and finally higher their ecological footprints initially. Third is Negative rich-country-illusion effect which is also technique used on macro level? It's a kind of behavior, which highpoints the incorrect brand of rich countries that the life style of economy is justifiable. This can be constructed for the imports of bio sink or bio capacity from less developed nations. Negative terms-of-trade distortion effect, it is a real story of lower class economies, the harsh reality of poorer economies, and their tendency towards the exploitation of natural resources beyond sustainable limits, only to sustain the terms-of-trade during high demand period. The possibility of trading the bio capacity with increasing income yields up in mind of poor nation. The economic growth is necessary state for better environmental conditions. According to Nordström and Vaughan (1999) ecological footprint tends to raise both in high income and low income countries due to such illusions.

3.3.3 An Overview of Ecological Footprint s by income groups

Per capita Ecological footprint of low income countries is 0.8, while middle income countries have 1.9 global hectares' per capita ecological footprints. Looking to the facts and figures, income growth expansion has increased resource use ratios of nations. Additionally, 6.4 global hectares' per capita ecological footprint was recorded on the account of high income group countries on the data sets of Global Footprints Network (2003). On the other hand, high income group have higher bio capacity of 3.3 global hectares, but unfortunately, still they are ecologically deficit countries. These countries are consuming 47 percent more, than what their environment can regenerate in one year. Low income countries have very diminutive bio capacity of 0.7 global hectares but still ecologically deficit nations. Only middle income countries are ecologically in surplus with bio capacity of 2.1 global hectares, auspiciously high than their ecological footprints [Global Footprints Network (2003)].

Figure 3.2 Ecological footprints by income groups



CHAPTER: 4

EMISSIONS OR CARBON FOOTPRINTS OF PAKISTAN OVER TIME

4.1 Introduction

This chapter shows time trends of CO_2 emissions in Pakistan calculated by author, using the products specific emissions. These time trends of exports imports, consumption and production tell us many active aspects of data, to know what is happening to the co2 emissions and ecological footprints over the time.

4.2 CO_2 Emissions of Exports, Imports, Production and Consumption

Total CO_2 emissions of export goods, increased initially up to 8.79 million metric ton in 1988, but reimbursed back to 5.2 million metric tons 1995. Because of production on higher scale, Pakistan exported more. The rising trend of Pakistan exports increased the CO_2 emissions from exports and it reached to 16.3 million metric tons in 2004. Growing faster the CO_2 emissions from exports of Pakistan, touched the remarkable 22 million metric ton in 2008, “while total emissions of Pakistan were 157 million tons” from agriculture, transport, manufacturing and energy sector [(ESP 2007-08)].

The reason for upward trends of emissions from exports of Pakistan might be the increasing trends of vehicles in trading sectors of the economy, which is, grown so fast. According to Pakistan Economic Survey 2006-07 the users of the road transport are also increased in 1990 there were 2.7 million vehicles, which have increased to 5.5 million in 2005, increasing it over 100%, and the growth continued to 9.8 million tons in next 3-4 years. Again, this trend came down to 1.61 million metric tons’ due decrease in exports

volume of the economy. Right After 2008 crises, strait to the time of floods in 2010 Co2 trend remain down as we were in need of such goods to allocate in our economy. Overall the exports emissions are increasing before 2008 and decreasing after 2009 tell date for selected specific goods. According to Research & Development Cell, PRGMEA (2012) The exports of cotton made products were diminished by 13.81% in total produce volume and were also augmented by 1.68% in monetary value. The decrease in production volume was due to the shortage of energy and increasing cost of inputs. Figure 4.1 shows highly volatile line, which represents the emissions from exports over the time. In last of 1980s our exports were growing and high polluting but after 1990, the slop remains almost zero over 5 years. Overall Increasing trend has been seen after mid 90s in CO_2 emissions from exported goods in Pakistan.

Figure 4.1 CO_2 Emissions of Export Goods

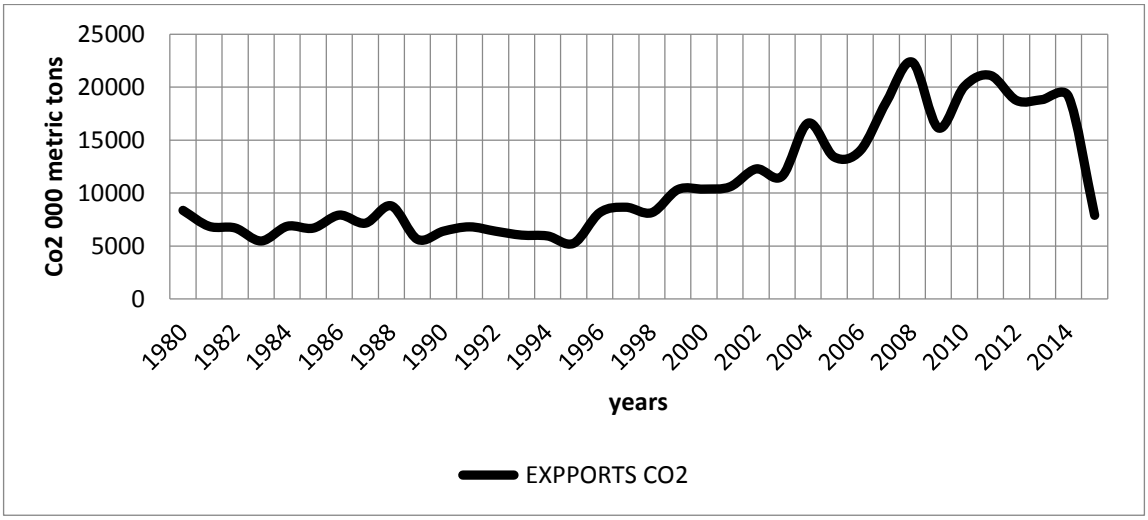


Figure number 4.2 indicates, that CO_2 emissions of production has shown a positive trend over the time from last 34 years however, the slop remained very low from the FY 1995 to FY 2001. Only from 1997-2001, somewhat an observable decline was noticed in CO_2 emissions from the production of selected commodities in Pakistan. Over all per

capita emissions from these commodities are increasing, which was 1.8 metric ton in FY 2007, while 2015 it reached to 2.13 metric tons on per person basis.

Figure 4.2 Carbon footprints or CO_2 Emissions of Production of Goods

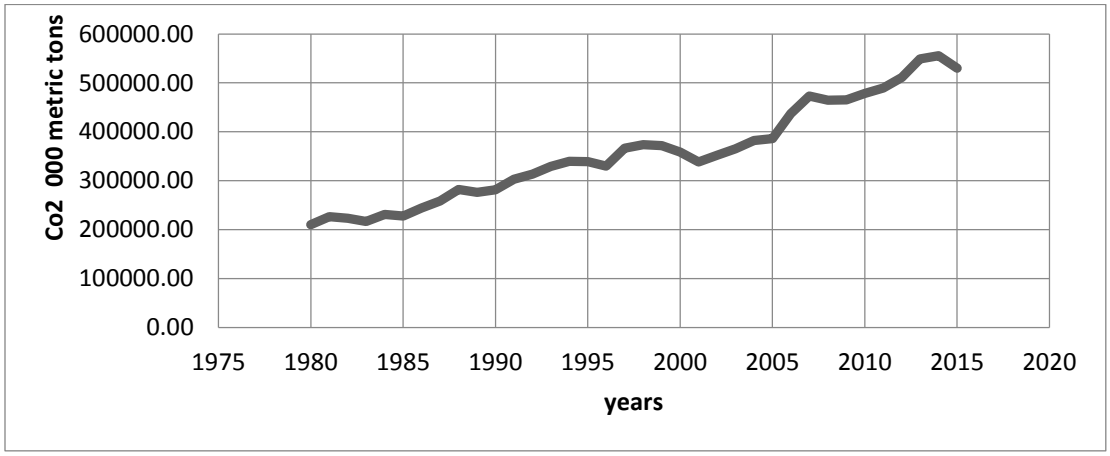
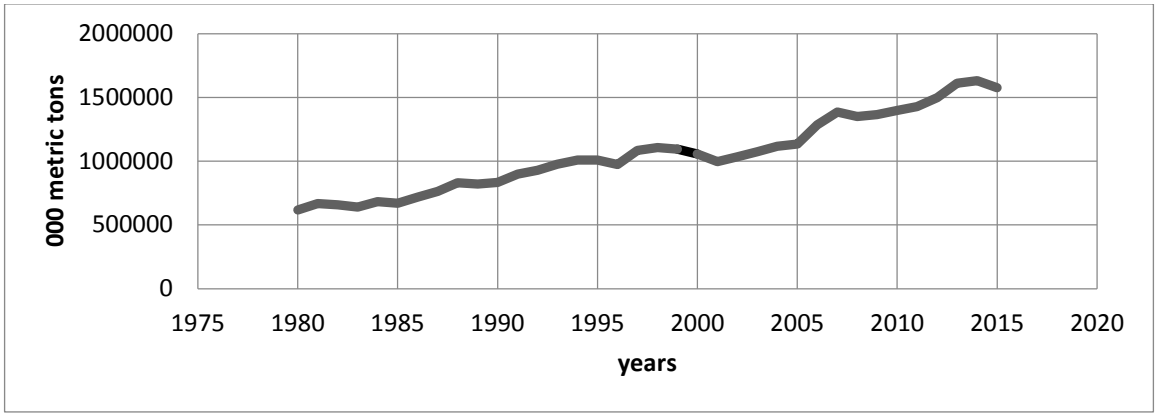


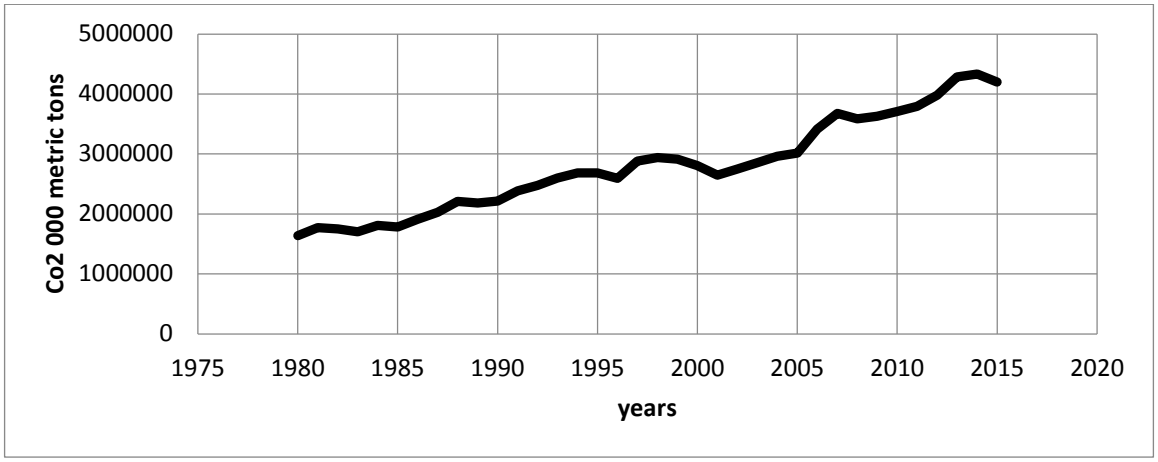
Figure no 4.3 shows positive trends over the time, this is due increasing consumption and imports over the time. Initially in 1980s Pakistan was importing products, which had 166293 thousand tons 'of embodied CO_2 emissions from other countries. These emissions have increased to 1630702 thousand tons in FY 2014. It is 0.83 tons' embodied emissions on per person. In other words, we are able to manage the negative environmental consequences of other nations by 0.83 tons on per person basis, which is going to affect the available bio capacity of the economy accordingly, but it's still environmental friendly as compared to Pakistan's own country production process for specific goods. Importing high polluting products, from the trading partners, Pakistan can save own bio-capacity. If this nation produce these environmental polluting products by own production process, that may cost higher environmental cost instead of trading it from other country.

Figure 4.3 CO_2 Emissions of Import Goods



The figure number 4.4 shows, that CO_2 emissions from consumptions of selected commodities have increased over the time. The increasing trend shows increasing demand for selected commodities, like Wheat, Rice, Rubber, Cotton, Cement, Fertilizer, Fish and Petroleum Products. The overall trend of CO_2 shown by other data scientists and organization looks quite similar to the graph given below in the current study.

Figure 4.4 CO_2 Emissions of Consumption of Goods



CHAPTER: 5

DATA AND METHODOLGY

5.1 Introduction

This chapter has distributed the theoretical background for the study idea and methods in interlinked steps. It covers theoretical background of the study, information about data, variables and methodology used in the study in detail.

5.2 Theoretical Framework

5.2.1 Ecological economics

The stand-up of ecological economics was seen in final eras of 20th century in connection to protect the environment and clench the actual taste of sustainable development. This branch of economics was a response to lack of biological groundwork in neoclassical economics. The intentions of infusing economics to moral philosophy was build a relation of ecology and resource management in reaction to the framework of unethical implications of neoclassical models depicting the humans as a rational and utility maximizing species on the planet (Capra & Pauli). Ecological economics is multiple dimensional efforts to manage the concepts and findings, coming from the nexus of nature and economic activities. Looking to background of the study area, ecological economics refers to the interaction between the ecology provide inputs to sustain and support our lives on one hand and on the hand resources are scares and increasing population need to manage it in way to go through the future. The main effects, concerning ecological economics are scale, distribution, and allocation. Scale is the size of economy against the understanding to resources availability and sustainability. Scale is

limited, that imply that economic growth is also limited. This is the actual priority of Ecological Economist to manage within limits of ecology and be restricted to some limits of growth. This is the point where the Ecological Economics is differentiated from Neoclassical, which believes in unlimited growth of an economy. Looking to other facts neoclassical school of thought refers to labour and capital resources allocation efficiently in a way that could maximize the production and economic growth (Standing, Jackson, Chen, Boudreau, & Watson, 2008).

But Ecological Economics focus on the efficient allocation of land and natural resources and consider these as factors of production. Natural resources are found to be only incompletely transposable by labour and manufactured capital. In ecological economics, the individual natural resources are also analysed to control, if they have the properties required for being allocated efficiently in the market. The current research is looking forward to the theories of ecological economic and trade economics. Scale effect, allocations effect (Ecological handprints), technical effect and composition effect in association with economic growth of Pakistan. For detail: see section 4.1.3. This study has used the following approaches to calculate Pakistan national level ecological footprints (Gilna, 2010).

5.2.2 Component and Compound-based approaches

This research has incorporated two basic ecological foot prints approaches. The first is component based approach, which is also known as bottom up method. This method calculates the footprint of individual product. The inclusive precision of results is subjected to the comprehensiveness of the elements list as well as the reliability of the life-cycle assessment (LCA) of each identified component. Current method offers a high

level of detail but has also some restricted distinct limitations. The component-based method also has some issues with gaps in available data and also with some proxies, like: indirect expenditures, which are not in the accounts of that organization, Such as public infrastructure and martial financial records. The only use of component based approach is not sufficient to conclude for national footprints significantly. The estimated standards through life cycle assessment method in the world are collected from different reliable sources of GFN, FAO etc. and these standards are incorporated to calculate the product specific Ecological Footprint for Pakistan. To overcome the shortcomings of component based approach, this study merges the application of both approaches to deal with case of nation Ecological footprints against the income growth and trade expansion of Pakistan. The results of this approach are more comprehensive than any sub national source besides LCAs and captures both straight and unintended consumption. Regarding the component method, there is no need to know, what share of the overall consumption resources were used for which purposes, as these are not perfectly documented in the records of statistical data groups (Wackernagel et al., 2002). Current study has brought these issues into bright colours lights for future literature, by disaggregating and aggregating the footprints of Pakistan.

5.2.3 Scale, Technological and Composition effects

The notion of this study is reflected by the theory that, income growth, Trade and industrial growth affects the environmental value in three different ways, the scale effects, technological effects and off-course the last but not least, the composition effects (Grossman & Krueger, 1991). To increase the level of output, higher level of inputs is needed and thus it requires more natural resources use in production process. This also

implies the higher level of emissions and waste generation, which directly and indirectly affect the environmental quality. Economic growth therefore, reveals a “scale effect” that devours negative influence on environment. Conversely, the economic growth can also demonstrate the positive effects on environment through the composition effect: which is, as the income increases, the construction of the economic inclines towards transformation and progressively up surges the cleaner activities that are more environmental friendly and produce less pollution. Environmental degradations have a tendency to intensifications structure of economy, which fluctuate from rural to urban or from agricultural sector to sector industrial, but also it started to fall with alternative operational change from energy intensive industry to services intensive industry. As a wealthy nation can have enough money to spend more on R&D (Komen, Gerking, & Folmer, 1997). The technological development occurs with growth in income and other economic indicators and the obsolete technologies, which cause high pollution and degradation to environment, are substituted by advanced new and cleaner technologies, resulting in the improvement of environmental quality.

The inverted-U shape may reflect changes in production supplementary to the economy’s stage of expansion and a segment between the emissions-intensity of production and the intensity of consumption (Arrow, Bolin, Costanza, & Dasgupta, 1995; Rothman, 1998)”. The economies trade pollution-intensive goods to the other economy in form of exports goods. This indicates the economy is on way to develop its path from less income to mid income, and finally to higher income groups. This is like economies are transforming from agricultural economies to heavy industrial economic structure and some transform to services. Subsequently food production tends to be less energy-concentrated (less

carbon-intensive). The Production process will become cleaner as compare to past. The inverted-U shape would be temporary, since every economy cannot specialize in services and production of each good to export. While a range of theories may have described the shape of the environmental Kuznets curve for air pollutants as well, Levinson (2001), but only the development-induced changes in production process coupled with trade stories seems plausible for carbon dioxide and income growth relationships in long run and short run. The current study has investigated EKC type relationship, where scale effect is quite dominant as compared to composition effect in the first model of consumption footprints table 6.1. On the other side, while in table 6.2, the Composition effect is more dominant as compared to scale effect of the increasing population and Income. Our results have shown that in Pakistan technical effect is dominated by all other observable theoretical effects, while dealing with income and trade in relation to Ecological footprints.

Table 5.1 Variables of the study

Variables of the study	Symbol	Variable source and unit
Per capita income growth	DPCIG	Statistical year books of Pakistan in millions
Consumption Footprints per capita	DCFP	Standard are taken from GFN, further authors calculations (Gha)
Import Foot prints per capita	DIMFP	Import Footprint per capita in Global hectares (Gha) Global Footprint Network, 2012 and Author's calculation
Production, Footprint per capita	DPFP	Production Footprint Per-capita Global hectares (Gha) Global Footprint Network, 2012 and Author's calculations
Exports footprints per capita	EXPFPC	Standards are taken from literature, GFN, author calculations.
Openness to Trade	DOT	Openness to Trade exports + imports, % of GDP (WDI)
Biological Capacity	DBC	Global hectares (Gha) Global Footprint Network, 2012
Services share	DSSHR	Services Share Value added (% of GDP) Economic survey of Pakistan (2015-16)

Agriculture share	DAGRSH	Agriculture share value added (% of GDP) Economic survey of Pakistan (2015-16)
Energy use per capita	DEUPC	Energy use per capita Tonne of oil equivalent WDI (2014)
Inflation GDP deflator	DINF	Taken from WDI (2015)
Population growth	DP	Taken from WDI in millions and Economic survey of Pakistan (2015-16)
Population density	PD	Economic survey of Pakistan (2015-16)
Technology	TECH	Assumption, that technology is improving over the time so study has used time as a proxy for technology.

5.3 Nature of Data used / Sources

The data of income growth is taken from World Development Indicators and statistical yearbooks of Pakistan. The study has used time series data for investigation process, where the selected commodities of trade is considered from 1980-2015, (35 years) as time series units. The data of traded commodities, wheat, cotton, rice, cement, fertilizers, and some other selected items is taken from statistical year's book of Pakistan and Pakistan economic surveys for the time of 1980 -2015 and some other sources like WDI, IFX and Federal Board of Revenue etc.

5.3.1 Ecological foot prints of imports

1) To calculate the ecological footprints of imports, first of all the data of selected commodities, Rice, Cotton, Wheat, Plastic, Polyester, Cement, Fertilizers, Petroleum products, Livestock meat, Paper and fish was converted into million tons' units imported. After converting to the units imported for all commodities, the data was further treated for imports ecological footprints calculations by multiplying the per unit standards with the total units imported for selected products for the time period of 1980 to 2015. In next

step, we sum up all the products footprints and subsequently the whole data set of the import ecological footprints was transformed to a single time series of imports ecological footprints series.

For example, if we have imported from China in million tons for that, we use the formula: total imports of specific product cement in 1980*3.5 (3.5 is Per Ton Ecological Footprint standard of China), which provided the value of Imported Cement Ecological Footprints. And so for other products in specific year with their specific standards, but if any country hasn't developed standard for specific product at that point, the author of current research has used the standard of adjust country or a country in same income group.

5.3.2 Ecological foot prints of exports

Per unit Ecological Footprints will be taken for selected commodities Rice, Cotton, and wheat livestock meat, Plastic, Cement and Fertilizers from Global Foot Print Network, other literature and worldwide published researches. One unit of each commodity standard Ecological Footprint is multiplied by total units exported to calculate the Ecological Footprints of exports. Furthermore, calculating exports footprints, one unit of production footprints of a good is multiplied by total exported units and the value for each product ecological foot prints is derived for of exports. All the products are taken from 1980 to 2015, where data series is merged to one time series for all the selected commodities by adding the horizontally all the product 1 + product 2 + product 3 eco footprints for specific year & so on.

5.3.3 Ecological foot prints of production

The manufacturing processes depend on some degree use of bio-capacity to be responsible for inputs and removal of wastes at several points in the process of producing a product. Hence these products carry an embodied Footprint. The trade of bio productive space can be seen inform of products trade. The present study calculates production ecological footprints by collecting the estimated standards published by GFN and other researchers at different studies, reports and articles. Per unit ecological footprints standards of Cement, Fertilizers, Wheat, Rice, Plastic, Polyesters, Papers and Fish products are multiplied by quantity produced to calculate the production footprints of any commodity. And at last stage, to make it single series, the horizontal summation of products ecological footprints is done, as Eco Foot Print of product one + Eco Foot Print of product 2 +Eco Foot Print of product 3 & so on

5.3.4 Ecological Footprint of consumption

It's important to investigate the direct and indirect bio-capacity, which is needed to sustenance of people's daily consumption. Consumer based approach is used, while calculating the Footprints for each area and type of few products. The Ecological Footprint of consumption (EFC) can be calculated as

$$\mathrm{EFc} = \mathrm{EFp} + \mathrm{EFi} - \mathrm{EFe} \ldots\ldots\ldots\ldots (5.1)$$

EFP is the Ecological Footprint of production and EFI and EFE are the embodied footprints traded inside the goods imported and goods exported, respectively. One of the benefits from the calculation of footprints at the national level is that, the level of aggregation, where the detailed and consistent production and trade data are available (Mózner, 2013).

5.3.5 Calculate the Ecological Carrying Capacity

We precede it using the methodology of (Zhang, 2005), the ecological carrying capacity replicates that resources, which are supporting the numbers of individuals, while not compromising the future carry capacity. In the calculation of ecological carrying capacity, as different countries or regions have different natural resource endowment, not only is the ecological production capacity of the unit area of arable land, pasture, forest land, build-up areas, oceans (or water areas) widely different, but the ecological productivity is significantly different as well. Thus, the similar biological productive areas of different countries and regions can't be compared directly. We need to adjust the different kinds of areas. The difference between regional output and world average output can be corrected with yield factor. As a result, the calculation formula of per capita ecological carrying capacity is:

$$ec = a_j \times r_j \times y_j \quad \text{(j= 1.2.3……...11)}$$

Where: ec is per capita ecological carrying capacity (hm^2 per person);

aj is per capita biological productive area;

rJ is equivalence factor;

yj is yield factor.

Regional ecological carrying capacity:

$$EC = N \times (ec)$$

Where: EC, is regional ecological carrying capacity of the total population (hm^2) dependent on these commodities and N is the number of people.

Bio-capacity

The current study has used a very logical methodology to calculate the bio capacity for each product or we can also use it on total sum of product ecological footprints. The emissions in tons are divided on Global average of all kind[11] of productive spaces yield, (2.34) multiply by the land equivalency factor for EF to covert it in global hectares, which is (1.4), to determine the biological productive space in land in global hectares' unit for Pakistan.

For example:

Emissions tones / Global average forest yield 2.34 = Hectares of bio-productive area* Land equivalency factor 1.4 = Bio Capacity in Global Hectares

5.3.6 Calculating the ecological deficit or ecological surplus.

If the Ecological Footprint calculation exceeds the regional ecological carrying capacity, the ecological deficit will appear. Similarly, if the Ecological Footprint is smaller than the regional ecological carrying capacity, the ecological surplus will appear. The regional ecological deficit or surplus reflects the natural resources used by people living in that region.

5.4 Econometric Methodology

This study has used thirty-five years annually time series data of selected trade goods and income growth with other covariates, from 1980 to 2015 for Pakistan. First the author has used the unit root test (ADF) for checking the stationary of the variables and the variables were stationary at first difference and some were stationary at level. None of the variable

in this study was stationary at 2nd difference.[12] After final test on data estimation, ARDL model was applied, to investigate the short run as well as long run relationship among the variables of interest. Moving on the logic of separately testing each of the four equations make us confident to avoid the problems of adverse variables selection that can affect the results.

After the confirmation of results the series are co integrated, the econometric model on this series are no longer spurious. The "ARDL Co integrating approach" was developed by Pesaran and Shin (1999) and Pesaran et al (2001). This technique provides better compensation in contrast with earlier and old-style Co integrating methods. Important is that, the ARDL technique, necessarily do not prerequisite the assumption that all the variables under study must be integrated of the same order and it can be applied, when the under-lying variables are integrated of order one, order zero or fractionally integrated. The second advantage is that the ARDL test is comparatively more effective in the case of small and fixed sample data. Lastly It gives better results for same type estimations (Harris and Sollis, 2003).

5.4.1 Econometric Modelling

This study has conducted time series analyses through ARDL on each of the following equations constructed according to the needs of study objective. It is also called bound testing method. The variables are explained for each model respectively. For detail variables and units of measure see table no 4.1. Long-run relationships between consumption footprints per capita and per capita income growth with other independent variables in multivariate time series analyses.

[12] See appendix C for detailed data diagnostic tests

This function was constructed on base of a concept, that (PCCEFP) Per Capita Ecological Footprints of Consumption are reallocated due to per capita income growth, and squared term of income growth. The effects of other variables like, (OTT), trade openness, (BC) bio capacity, (POPG) population Growth, and (ENPC) Energy per capita are included in the modeling for more precise measurement.

The Equation for Per Capita Ecological Footprints of Consumption is formulated as[13]

$$\mathrm{EFCPC} = \beta o + \beta 1\mathrm{PCIG} + \beta 2\mathrm{PCIG2} + \beta 3\mathrm{OTT} + \beta 4\mathrm{POPG} + +\beta 5\mathrm{BC} + \beta 6\mathrm{ENPC} + et \ldots\ldots\ldots\ldots (5.2)$$

According to Munir and Khan (2013), to check the robustness of Inverted U shaped EKC, we can add some other variables, in our case, like bio capacity and trade openness to the analysis. I have carried on this process on the Equation (1) to formulate the following ARDL method. The process is reflected in Equation (5) for Per capita Ecological Footprints and Income growth with some other supporting explanatory variables. But before going for final estimation of each ARDL model, I have used Model selection criteria, AIC and SIC and graph which indicated the selection of best model amongst the given number of models.

The equation for per capita of production ecological footprints is formulated as,

$$\mathrm{PCPEFP} = \beta o + \beta 1\mathrm{GDP} + \beta 2\mathrm{PGDP2} + \beta 3\mathrm{OTT} + \beta 4\mathrm{BC} + \beta 5\mathrm{PP} + \beta 6\mathrm{INF} - \mathrm{GDP} + \beta 7\mathrm{ENRGPC} + \beta 8\mathrm{TEC} + \varepsilon t \ldots\ldots\ldots\ldots (5.3)$$

[13]To proceed with best results, current study has follow, Cameron (1994) By converting the linear function to log linear model, so we write the function as follows, The Consumption ecological footprints, per capita is dependent on Log of Per capita Income Growth (LPCIG), Log of Squared term of Per capita Income growth (LPCIG^2), which is added to equation to track the linearity of relationship between the income growth and per capita footprints of consumption, which implies, that squared term determines the turning point of the relationship. In other words, the response of consumption footprints per-capita to income growth per capita is observed through this squared termed, which provide the evidence of EKC.

The above equation is specified to test the long run relationship determinants of Ecological Footprints per capita, where the squared terms of these variables will indicate that increasing GDP and Per capita at initial stages increasing the pollution through importing the dirty products in terms of high embodied energies in it, but after a certain level the ecological footprints of export products starts declining trend, which is a proposition on the basis of EKC (1955). The argument that, achieving a certain level of income, the economy improves production process over the time and hence exports the cleaner products to other countries and can also consequently reduces the Exports eco footprints per capita of the economy in long run. In this regards the composition effect, scale effect and technical effects are famous to insure the better understanding of the said notion (And the same applies to equation 3 and for 4).

The equation for exports ecological footprints can written as follows,

$$[\mathrm{EXPPF} = \beta o + \beta 1\mathrm{INCG} + \beta 2\mathrm{INCGR2} + \beta 3\mathrm{ENPC} + \beta 4\mathrm{BC} + \beta 5\mathrm{TEC}$$

$$+ \beta 6\mathrm{service}_{\mathrm{share}} + \varepsilon t \ \ldots\ldots\ldots\ldots (5.4)]$$

Long-run relationships between Exports footprints to production of home country with other independent variables in multivariate time series analyses can expressed as in the following equation. Exports footprints of Pakistan are relocated by GDP Per capita, per capita income growth squared, energy per capita bio capacity technology and Services share. But the response of both the variables is expect to be quite different to export footprints due to scale or composition effects.

The equation for imports against explanatory variables

$$\text{IMPFP} = \beta o + \beta 1\text{PCIG} + \beta 2\text{PCIG2} + \beta 3\text{BC} + \beta 4\text{OTT} + \beta 5\text{POPGRW} + \beta 6\text{INFL} + \text{et} \ldots\ldots\ldots\ldots\ldots (5.5)$$

5.4.2 Auto / regressive distributive lags (ARDL)

This model was introduced by Pesaran et al. (2001) The ARDL bounds test assumes that the variables should be stationary at I (0) or I (1). So, before applying this test, it's important to determine the order of integration of all variables using the ADF unit root tests. By ensuring that the variables were not I (2) so as to avoid spurious results. In the presence of variables integrated of order two can lead to misinterpretation of value F statistics provided by (Pesaran, Shin, & Smith, 2001) .

General form of the model

$$Yt = A + B\sum Yt - i + BXt + B\sum Xt - i + Ut$$

Yt is the dependent variable and A is the intercept

Yt-i is the lagged dependent variable

Xt is the independent variable,

Xt-i is the lagged independent variable

Ut is the error term

5.4.3 Model Specification

Functional form of ARDL:

Model for relationship between Income growth and Per capita Ecological footprints with one lag optimum number of lag through checking AIC SIC criteria

$$DPCCFP_t = \alpha_t + \beta 1 DPCIG_t + \beta 2 DPCIG_{t-1} + \beta 3 DPCIG_t^2 + \beta 4 DPCIG_{t-1}^2 + \beta 5 DOTT_t + \beta 6 DOTT_{t-1} + \beta 7 POPG_t + \beta 8 POPG_{t-1} + \beta 9 DBC_t + \beta 10 DBC_{t-1} + \beta 11 ENRGPC_t + \beta 12 ENRGPC_{t-1} + \varepsilon_t consumption \ldots\ldots\ldots (5.6)$$

Functional form of ARDL: Model for production Ecological footprints and income growth relationship

$$PCEPFP_t = \alpha_t + \beta 1 PCPFP_{t-1} + \beta 2 PCIGRW_t + \beta 3 PCIGRW_{t-1} + \beta 4 PCIGRW_{t-2} + \beta 5 PCIGRW_{t-3} + \beta 6 PCIGRW_t^2 + \beta 7 (\mathrm{POPG})_t + \beta 8 (OTT_{t-1} + \beta 9 ENRGPC_t + \beta 10 ENRGPC_{t-1} + \beta 11 BC_{t+} \varepsilon_{tprod} \ldots\ldots\ldots (5.7)$$

Functional form of ARDL: Model for Ecological footprints of Imports and income growth with some other independent variables.

$$DIMFPPC_t = \alpha_t + \beta 1 DIMFPPC_{t-1} + \beta 2 DPCIG_t + \beta 3 DPCIG_{t-1} + \beta 4 DPCIG_t^2 + \beta 5 DPCIG_{t-1}^2 + \beta 6 \mathrm{POPG_t} + \beta 7 \mathrm{POPG_{t-1}} + \beta 8 DTECH_t + \beta 9 DTECH_{t-1} + \beta 10 DBC_t + \beta 11 DBC_{t-1} + \varepsilon_t imp \ldots\ldots (5.8)$$

Functional form of ARDL: Model for exports Ecological footprints and income growth

$$DEXFPPC_t = \alpha_t + \beta 1 DEXFPPC_{t-1} + \beta 2 DPCIG_t + \beta 3 DPCIG_{t-1} + \beta 4 DPCIG_t^2 + \beta 5 DPCIG_{t-1}^2 + \beta 6 DPoP_t + \beta 7 DPoP_{t-1} + \beta 8 TECH_t + \beta 9 DTECH_{t-1} + \beta 10 DBC_t + \beta 11 DBC_{t-1} + \beta 12 DGDP_t + \beta 13 DGDP_{t-1} + \beta 14 DGDP_t^2 + \beta 15 DGDP_{t-1}^2 + \varepsilon texp \ldots\ldots (5.9)$$

5.4.4 Theoretical Justification

The relation between income and ecological footprints is explained in very detail in chapter one and two, however the relationship is nonlinear in nature, which is more precisely explored in relation with effects, coupled with economics activities. The concept of trade and ecological footprints could be easily expressed by a concept given by Andersson and Lindroth (2001), who listed different channels, that how possibly income and trade can touch our environment, particularly the ecological footprints as such as Positive allocative effect, "which reflect the reduction of ecological footprint as the trade enables an economy to get specialization on a product, which is produced with a higher productive yield" This concept was quite convincing to investigate either it works for Pakistan or not to reduce the environmental pressure, that's the reason, we included the trade expansion to the current study, as an independent variable.

Negative income effect, which increases ecological footprint as trade helps countries raise their income, and thereby, consumption, this effect in the current study is tracked by including both together however, it's not the objective of this research to look for specific kinds of effects. Pakistan exports are saving biological productive space of trade partners and so is Pakistan gaining from the trade and vice versa. Negative terms-of-trade distortion effect. This is the indications of a tendency for poor countries to exploit natural resources, beyond the limits of sustainable using scales to protect the economy from falling terms-of-trade during bust periods in world demand. The likelihood of trade in the bio-sink-capacity with increasing income can also create another delusion on the side of poor countries that economic growth is the necessary condition for a better environment (Nordström and Vaughan, 1999).

Consequently, this can push the ecological footprint to climb up both in rich and poor countries. Therefore, it is essential to consider the effects of international trade, when dealing with income-environmental quality relationship in EKC framework. This is one of the important cause of trade inclusion to this research, while calculating the Pakistan ecological footprints.

The four listed effects worked through several selected variables and it reallocates the shape of EKC too and This is what the current research work has taken into account. For this purpose, a separate analysis for each of the income-effect is done, (after controlling for some other explanatory variables on ecological footprints incurred by domestic production and imports. This is the major reason behind the separate modelling for specific economic activity.

CHAPTER 6

RESULTS AND DISCUSSION

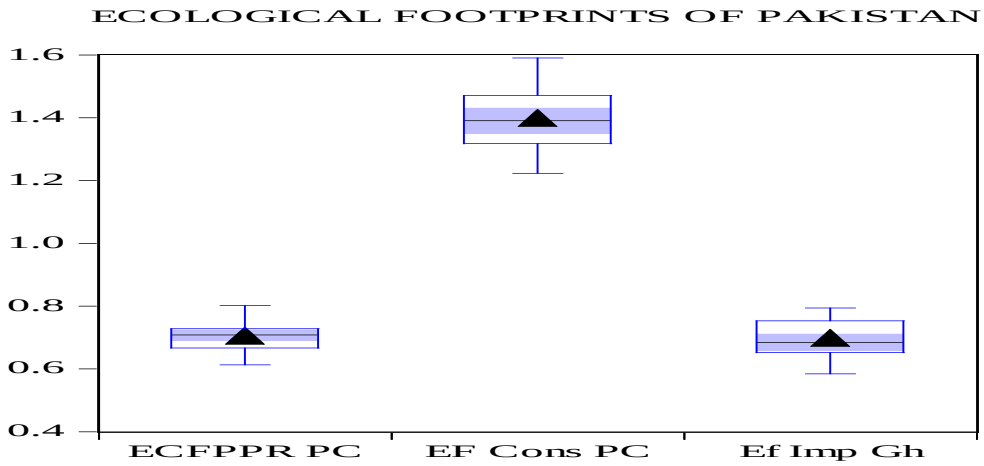
6.1 Introduction

This chapter is composed of two major sections, where first section holds descriptive results and Section 2 cover up the empirical results of the study. Starting from simple illustration of Per Capita Ecological Footprints for specific economic activity, like Production, Consumption and Imports of Pakistan. This chapter displays all the discussions, organized around the current study results. However, our results are supported by some authors for specific concepts and also opposed by some very recent studies conducted by cited authors. The closing statements of this chapter are the major findings and answers to the research question posed by the author of the current study in chapter 1.

6.2 Descriptive Statistics

Figure 6.1 shows that, the Production Per capita Ecological Footprints of Pakistan is very close to import Ecological Footprints but quite smaller than Consumption Footprints per capita. These findings are aligned with results of Acer (2015) and Adly (2015) argued that when initially income rises Ecological footprints of imports nurtures faster than Production footprints of developing countries. In case of our estimations, imports footprints are less than production footprints with minor difference. Higher Consumption foot prints are the confirmation Pakistan has gone through consumption driven pollution. The imports footprints of Pakistan contribute 45% to its total Consumption Footprints. It implies that Pakistan also need to pay attention to manage the incoming pollution along with own country produced emissions.

Figure 6.1: Ecological Footprints[14] of Pakistan by Economic Activities

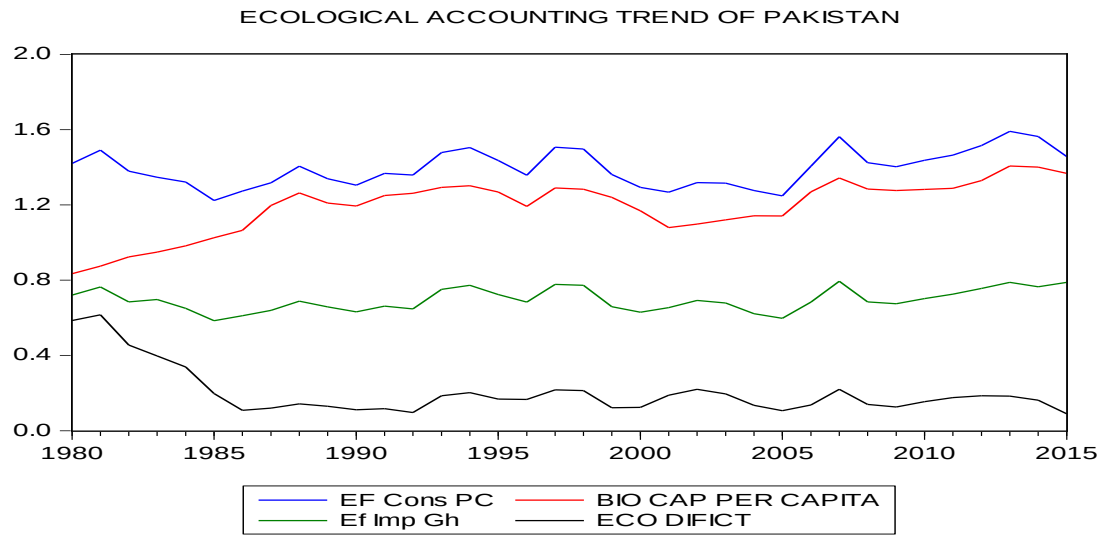


6.2.1 Ecological Accounts of Pakistan over Time

Figure 6.2 shows, increasing bio capacity due to agriculture intensification with better seeds, better technology, conversion of barren lands to cultivable lands and changing the imports composition to cleaner goods appears helpful for Pakistan, to reduce the Ecological deficit in the future, as we move towards development. The economy of Pakistan has increased the agriculture land area, water storing capacity, through dams and water reservoirs. But unfortunately, Pakistan is still an ecologically deficit economy. Because what the nature can provide around the year Pakistan is using 33% higher than that. However, the gap between ecological footprints and bio-capacity is decreasing and it is expected that biocapicity will take the lead in few years, if said environmental budget is efficiently managed. For detail see appendix

[14] On X axis's it shows ecological footprints for which, the Unit of measurement is land required in Gha and on Y axis's different economic activities

Figure 6.2 Ecological Accounts of Pakistan over Time[15]



6.2.2 Pakistan Ecological Footprints of Production, Exports Imports and Consumption over time 1980-2015

The figure number 6.3 shows, that production footprints of Pakistan from selected commodities have increased over the time. The slop has remained very low due to high imported goods from other countries, what we can't produce in Pakistan. The imports footprints per capita of Pakistan as almost close to the production footprints per capita. The overall trend remains positive and increasing, however some ups and downs are noticed over the time.

[15] The unite of measurement for ecological footprints is land required in Gha for specific activity, person or a product to support daily resource use over the year

Figure 6.3 Production Footprints of Pakistan[16]

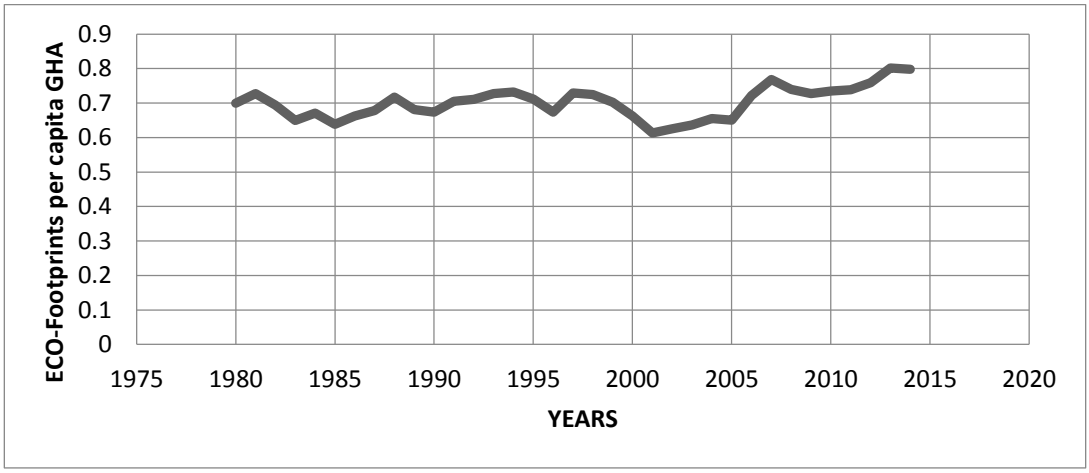


Figure 6.4 shows, that Change in exports composition is redirecting the ecological footprints but overall the data show increasing trend but in 2009 the financial crises bring the trend down to the level of 1995 ecological footprints of Pakistan from exports.

Figure 6.4 Exports Footprints of Pakistan

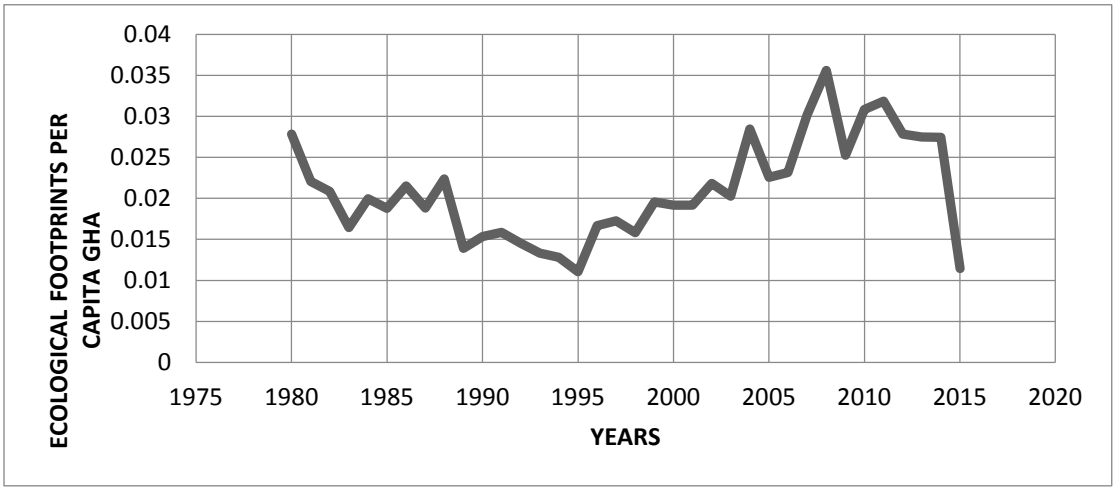


Figure 6.5 shows that consumption footprints of Pakistan are increasing over all. Peak point was 2007, after the 2008 crises the ecological footprints are showing declining trend, while right after very short time, the trend has resolved to the past year's slop

[16] Land required in Gha for activity or any product

Figure 6.5 Consumption Footprints of Pakistan

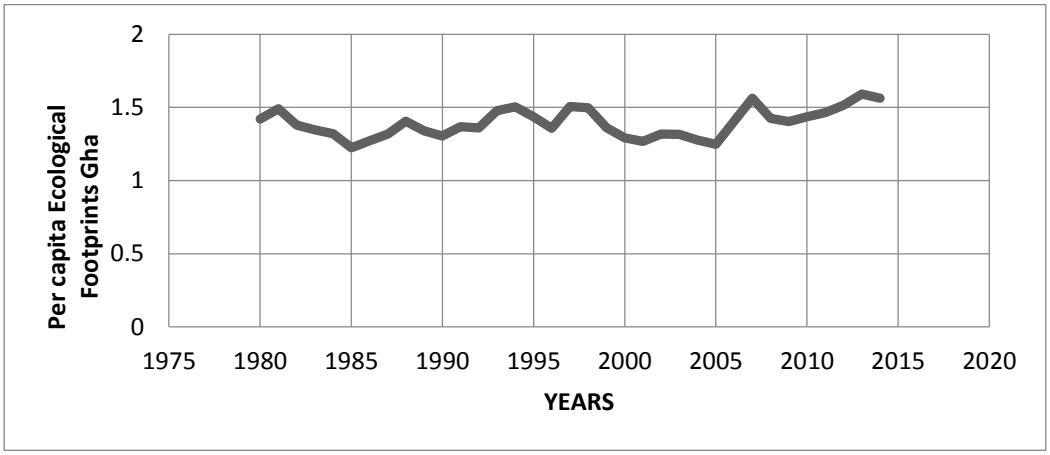
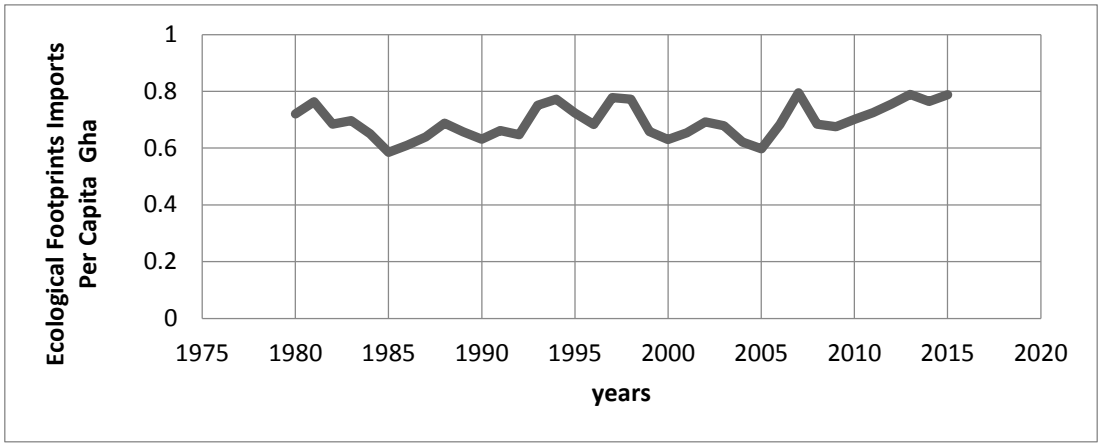


Figure no 6.6 Indicates that the ecological footprints of imports are steady and increasing over the time, for some specific decline has been noted, where it might be because of changing products mix composition and host country own production and demand gap. Higher demand and limited supply has encouraged the imports footprints in Pakistan as of lack of ability to produce and satisfy demand of the nation from self-sufficiency in production.

Figure 6.6 Imports Ecological Footprint



6.3 Diagnostic Test on data used

This study has used ADF test to check the stationary of the data considered for the analysis. Also, to check the order of Co integrating for each series, current research has employed Unit root test. The study has confirmed that each series is 1(1) however 1(0) series are also the part of study data sets, but not any single series was integrated of order 1(2). To ensure that the results are not spurious, furthermore current study has used some other tests. The diagnostics test included Durbin Watson test to check autocorrelation for each series, LM test for serial correlation, where all the series of the data is brought away from all the econometric issues, without forgetting the multicollinearity and heteroscedasticity.[17] For details see appendix

6.4 Results

a) Income Growth and Consumption Footprints

Table number 6.1 shows results, where initially real income growth has increased the Ecological Footprints of Pakistan. But current income growth has no significant relationship with Ecological Footprints of Consumption. It means that Per Capita Consumption Ecological Footprints are not responding to Current Income growth. However, the income growth squared is negative and statistically significant. This indicates that Income growth after some time leads towards increasing demand for better Environment and consequently reduces the pollution.

[17] To proceed with best results, current study has follow, Cameron (1994) By converting the linear function to log linear model, so we write the function as follows, The Consumption ecological footprints, per capita is dependent on Log of Per capita Income Growth (LPCIG), Log of Squared term of Per capita Income growth (LPCIG^2), which is added to equation to track the linearity of relationship between the income growth and per capita footprints of consumption, which implies, that squared term determines the turning point of the relationship. In other words, the response of consumption footprints per-capita to income growth per capita is observed through this squared termed, which provide the evidence of EKC.

There exists an EKC inverted U shaped relationship between Income growth and Per capita Ecological footprints of consumption. But looking to facts it looks like Income growth has significant lag effects on Per capita Ecological Footprints of Consumption. The Eco-Footprints of consumption is positive affected due to increasing population and upgrading scale of production to higher level, which impose scale effect to current nexus of Income Growth and Ecological Footprints. Current study indirectly indicates, that reallocation seems as a result of composition effect, where imports composition changes have been observed over time. Increasing income some time effects the demand patterns, which might be a movement toward dirty goods and this composition might also be sometime comprised of cleaner products as well. Nation's Ecological Footprints are drawn up by increasing bio capacity [18]Acer (2015).

Pakistan Consumption Footprints are positively associated with Trade openness, which implies the theory of negative income effect. Which postulates, that trade increases income, which leads to higher consumption and Energy per capita and thus increase the ecological footprints of a nation? However, the relation between energy Percapita and environmental pressure is statistically not significant in our estimation. Pakistan footprints are positively associated with increasing [19]Bio capacity and strongly significant. This effect has led by intensified agriculture and efficient utilization of available resources as compared to past for specific products. And this is aggregated

[18] In this case economy has rich resource background and thus tries to utilize it for more development, which cause adverse environmental consequences in form of emission to the atmosphere.

[19] Bio capacities help us to produce more, which ultimately increase the supply of resources from nature. It can be done by the potential optimization of bio capacity through regional planning of land use, specially, water resource management and arable land management. It also includes efforts of better resource management to gain higher marginal benefits. These efforts enhance our aggregate production and supply of food and other usable goods, which increases the ecological footprints in same direction.

estimation followed by the disaggregated estimations of imports, production and exports ecological footprints.

Table 6.1 Relationship between Income growth and Consumption Footprints

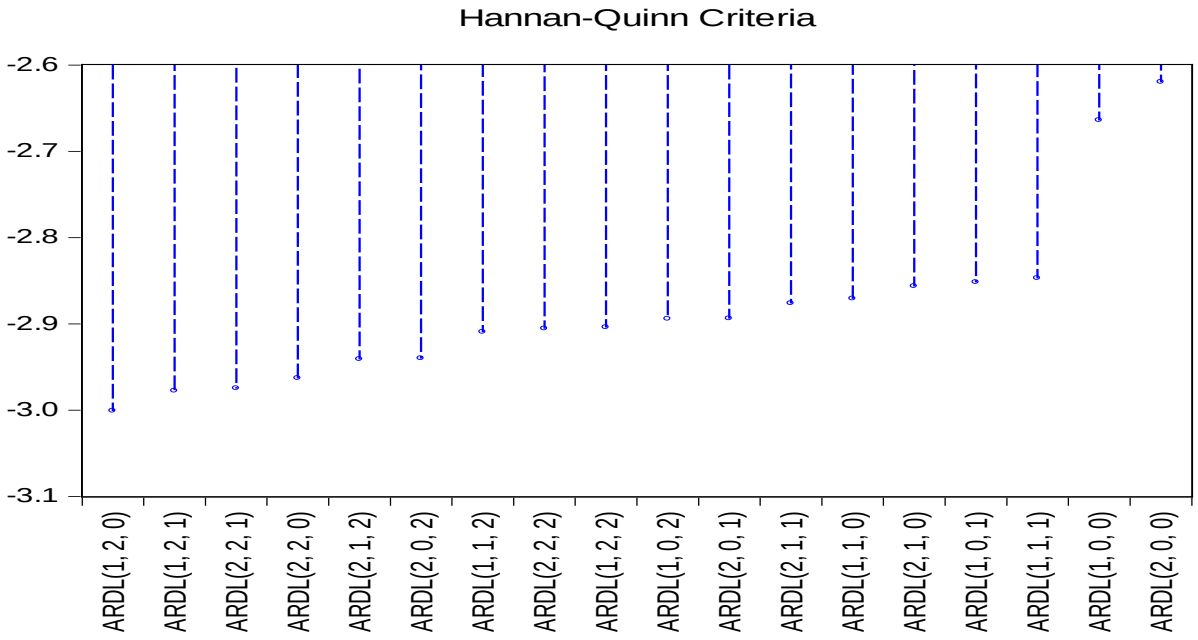
Dependent Variable: Eco Foot prints of Consumption Per Capita				
Method: ARDL: Date: 01/09/17 Time: 02:08, Sample (adjusted): 1982 2015, Included observations: 34 after adjustments, Maximum dependent lags: 2 (Automatic selection)Model selection method: Hannan-Quinn criterion (HQ)				
Selected Model: ARDL (1, 2, 0), Number of models evaluated: 18				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
EFCPC (-1)	0.450652	0.103562	4.351513	0.0002
PCIGRW	0.308122	0.558901	0.551299	0.5865
PCIGRW (-1)	0.851053	0.448982	1.895519	0.0701
PCIGRW (-2)	0.891535	0.382376	2.331568	0.0284
PCIGRWSQ	-15.06593	4.749748	-3.171944	0.0041
OTT	2.466511	2.535393	0.972832	0.3403
POPG	0.000158	0.000806	0.195852	0.8464
BC	0.464024	0.097117	4.777988	0.0001
ENPC	3.78E-05	0.000450	0.084028	0.9337
C	0.053145	0.211093	0.251759	0.8034
R-squared	0.849036	Mean dependent var		1.391719
Adjusted R-squared	0.792425	S.D. dependent var		0.097322
S.E. of regression	0.044340	Akaike info criterion		-3.153908
Sum squared resid	0.047186	Schwarz criterion		-2.704979
Log likelihood	63.61644	Hannan-Quinn criter.		-3.000810
F-statistic	14.99763	Durbin-Watson stat		1.965677

Prob(F-statistic)	0.000000	

b) Consumption Footprints Model Selection Criteria

Figure number 6.5 shows, Model selection is based on Hannan-Quinn criteria minimum value show. This model is preferred over model in the series. However, author has seen other models results as well but this model stands better fit. Furthermore, the study has jointly checked the long run relationship hypothesis through bound testing approach to see either we can proceed further for short run and long run Cointegrating or not.

Figure 6.5



c) ARDL Bounds Test for Income growth and Consumption footprints

Here in this case the F Statistics value is greater than each critical bound value, especially the upper bound value. There is no need change the variables. It allows us to reject the null hypothesis and we proceed further to check the long run and short run relationship between these variables through ARDL Co integrating form as well as long Run form.

Table 6.2: Relationship between income growth consumption footprints

ARDL Bounds Test		
Date: 01/09/17 Time: 02:13, Sample: 1982 2015, Included observations: 34		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	[20]12.03373	2
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

Table 6.3 shows long run coefficients of Income growth and its squared term are statistically significant, which validate the existence of Traditional EKC inverted U shaped relationship in Pakistan in long run. It is also noted that short run and long run coefficients are responding the same way but only current income growth in short run is insignificant to reallocate the footprints of consumption in Pakistan.

In long-run current income growth and Squared term of Income growth have got the expected signs and strongly significant. Population growth shows positive but statistically insignificant impact on consumption ecological footprint. This implies Pakistan Consumption footprints are surprising but it is the resulting changes in combination of products consumed every year. Bio capacity in long run is highly significant and Pakistan Footprints do a quick reply to increasing bio capacity by positive significant sign. Now

[20] The F Statistics is decision making value, if it is less than upper bound value. It is inconclusive to reject the null hypothesis, that there is no long-run relationship. In this case, we often drop or we add some variable to model.

this plausible to think, what will be left to future generation? This is good for growth but it might be a doubt for sustainable development. In long run consumption, Per capita Ecological footprints of Pakistan does show any significant relationship with Energy Per capita but however the sign is positive, which means, increasing energy use is leading to high Ecological Footprints in future.

Table 6.3 Ecological Footprints of Consumption Per Capita income growth in ARDL Co integrating and Long Run Form

Dependent Variable: Ecological Footprints of Consumption Per Capita, Selected Model: ARDL (1, 2, 0), Date: 01/09/17 Time: 02:15, Sample: 1980 2015, Included observations: 34				
Short run coefficients Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PCIGRW)	0.308122	0.558901	0.551299	0.5865
D (PCIGRW (-1))	-0.891535	0.382376	-2.331568	0.0284
D(PCIGRWSQ)	-15.065934	4.749748	-3.171944	0.0041
D(OTT)	2.466511	2.535393	0.972832	0.3403
D(POPG)	0.000158	0.000806	0.195852	0.8464
D(BC)	0.464024	0.097117	4.777988	0.0001
D(ENPC)	0.000038	0.000450	0.084028	0.9337
CointEq(-1)	-0.549348	0.103562	-5.304521	0.0000
Cointeq = EFCPC - (3.7330*PCIGRW -27.4251*PCIGRWSQ + 4.4899 *OTT + 0.0003*POPG + 0.8447*BC + 0.0001*ENPC + 0.0967)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCIGRW	3.732991	1.538742	2.426002	0.0232
PCIGRWSQ	-27.425130	11.525478	-2.379522	0.0256
OTT	4.489889	4.854778	0.924839	0.3643
POPG	0.000287	0.001449	0.198271	0.8445
BC	0.844682	0.196410	4.300613	0.0002
ENPC	0.000069	0.000825	0.083479	0.9342
C	0.096742	0.371365	0.260502	0.7967

Table number 6.4 shows, Per capita ecological footprints of Pakistan imports are significant with its own lagged effect. Current income growth and last year income growth are insignificant and have positive sign coefficients, while 2 years back the income growth has given a significant response, getting positive and significant sign. This implies that imports footprints are positively enhanced due to previous years' income growth but current income growth squared term has given theoretically justifiable sign. Negative sign means after increasing income to some level Pakistan imports per capita ecological footprints tends to decrease as income goes higher and higher. However, the bio capacity of Economy allows Pakistan to import more negative environmental consequences on the hope of our increasing incremental absorption capacity.

More biological productive space does not mean that we can produce as much as we need, but it indicates that Pakistan can import with fear of environmental pressure, what Pakistan economy cannot produce within the boundaries, aware of the fact that our absorption capacity is manageable as we go rich and richer over time. The statistics show that technology improvement over the time is helping economy to decrease the environmental pressure but not quite significantly in our case. There does not appear and U shape EKC in this case but it will be more plausible to check this relation in short run and long run Co integrating through ARDL. The given model is strongly preferred over given set of models on the base of Akaike information criteria.

Table 6.4 Results of Imports Ecological Footprints and Income growth

Dependent Variable: EF_IMP_GH				
Method: ARDL				
Date: 01/09/17 Time: 00:19, Sample (adjusted): 1982 2015				
Maximum dependent lags: 4 (Automatic selection) Model selection method: Akaike info criterion (AIC), Included observations: 34 after adjustments				
Number of models evalulated:100, Selected Model: ARDL (1, 2, 1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
EF_IMP_GH (-1)	0.435556	0.126217	3.450839	0.0021
PCIGRW	0.052838	0.451884	0.116929	0.9079
PCIGRW (-1)	0.332085	0.468339	0.709070	0.4851
PCIGRW (-2)	0.675097	0.304539	2.216780	0.0364
PCIGRWSQ	-8.690138	3.323520	-2.614739	0.0152
PCIGRWSQ (-1)	1.038083	2.898356	0.358163	0.7234
POPG	0.004836	0.005435	0.889853	0.3824
TECH	-0.018075	0.022162	-0.815579	0.4228
BC	0.208579	0.074199	2.811063	0.0097
C	-0.378514	0.480102	-0.788404	0.4382
R-squared	0.739573	Mean dependent var		0.692122
Adjusted R-squared	0.691914	S.D. dependent var		0.059278
S.E. of regression	0.035472	Akaike info criterion		-3.600199
Sum squared resid	0.030199	Schwarz criterion		-3.151269
Log likelihood	71.20338	Hannan-Quinn criter.		-3.447101
F-statistic	7.572946	Durbin-Watson stat		1.867544
Prob(F-statistic)	0.000035			

Figure 6.6 explains the selection of imports model, which was based on the Akaike information selection criteria among the 20 models

Figure 6.6 Imports footprints Model selection criteria

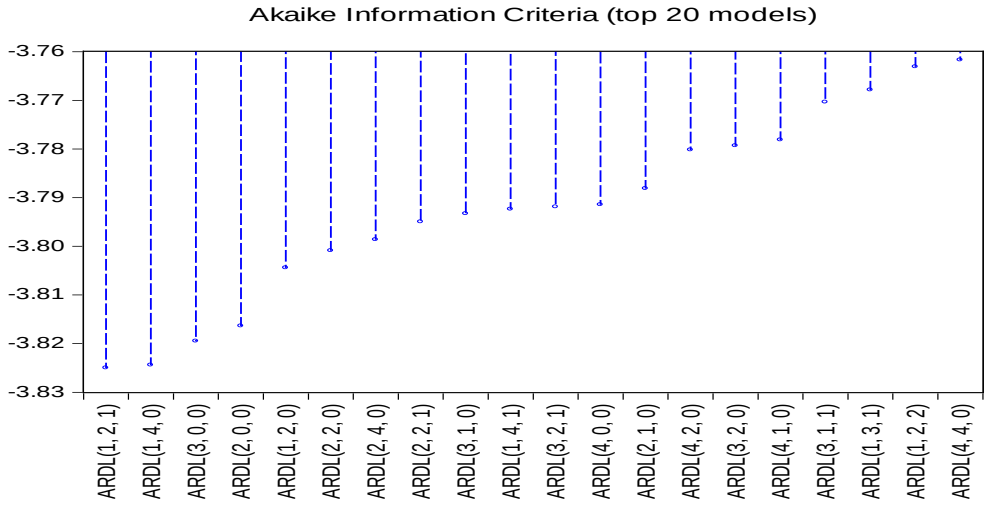


Table no 6.5 shows that, the bound test value F statistic is significantly higher than the given lower and upper bound values, which allows author to proceed further for ARDL long run Cointegrating. The upper bound value is less than F value, which indicate that we can reject the null hypothesis of no long run relationship but to find the clear answer to the proposed relationship between given set of variables, let's see what it brings in short run as well as long run form.

Table 6.5 ARDL Bounds Test for Imports Percapita Footprints

Date: 01/09/17 Time: 00:29¸Sample: 1982 2015, Included observations: 34		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	10.37026	2
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

Table number 6.6 results show that, import per capita footprints are reallocated by increasing income in short run but it looks like, that Pakistan increasing income in long run might reallocate the Footprints of goods Imported. Growing population encourages high imports but changing demand patterns after reaching to threshold level of income growth discourages the pollution inflow and negative environmental consequences of other countries to hosting nation.

That implies that after some time of economy is able to produce these commodities, which are imported from other countries due to no of factors like growing population and growing [21]bio capacity. But also, it implies that economy start carrying environment through many directions, like working on better environment friendly technology and strengthening environmental laws and act. In case of Pakistan currently we do not care what environmental friendly and what are environmental damaging goods that we are importing every year from our trading partners, but important is the current demand for growing population and composition change with significant increasing bio capacity of the economy over time through various environment upgrading acts and activities.

[21] The bio capacity of the world is increased over last 50 years, because of high intensive agriculture that allow us to produce more per acer as compared to the per acer production, 50 years back.

Table 6.6 ARDL Co integrating and Long Run Form for Imports Footprints

Dependent Variable: EF_IMP_GH				
Selected Model: ARDL (1, 2, 1)				
Included observations: 34				
Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PCIGRW)	0.052838	0.451884	0.116929	0.9079
D (PCIGRW (-1))	-0.675097	0.304539	-2.216780	0.0364
D(PCIGRWSQ)	-8.690138	3.323520	-2.614739	0.0152
D(POPG)	0.004836	0.005435	0.889853	0.3824
D(TECH)	-0.018075	0.022162	-0.815579	0.4228
D(BC)	0.208579	0.074199	2.811063	0.0097
CointEq (-1)	-0.564444	0.126217	-4.471994	0.0002
Cointeq = EF_IMP_GH - (1.8780*PCIGRW -13.5568*PCIGRWSQ +				
0.0086*POPG -0.0320*TECH + 0.3695*BC -0.6706)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCIGRW	1.877990	1.190812	1.577066	0.1279
PCIGRWSQ	-13.556804	7.672109	-1.767025	0.0899
POPG	0.008568	0.009107	0.940798	0.3562
TECH	-0.032023	0.037257	-0.859515	0.3986
BC	0.369530	0.149102	2.478372	0.0206
C	-0.670597	0.831701	-0.806295	0.4280

Table 6.7 shows that, Income growth of Pakistan is significantly reallocating the per capita ecological footprints of Pakistan, initially positively increasing with decreasing rate Production footprints are declining after income growing for certain years. It reflects to the existence of a well-organized and justifiable relationship between income growth and per capita of production ecological footprints in case of Pakistan. The main variables of model are highly significant and providing expected signs according to the Theory of Kuznets (1957), where Pakistan initially produce higher polluting products but after increasing the level of income to a certain threshold, better steps are taken to reduce the pollution of production sector.

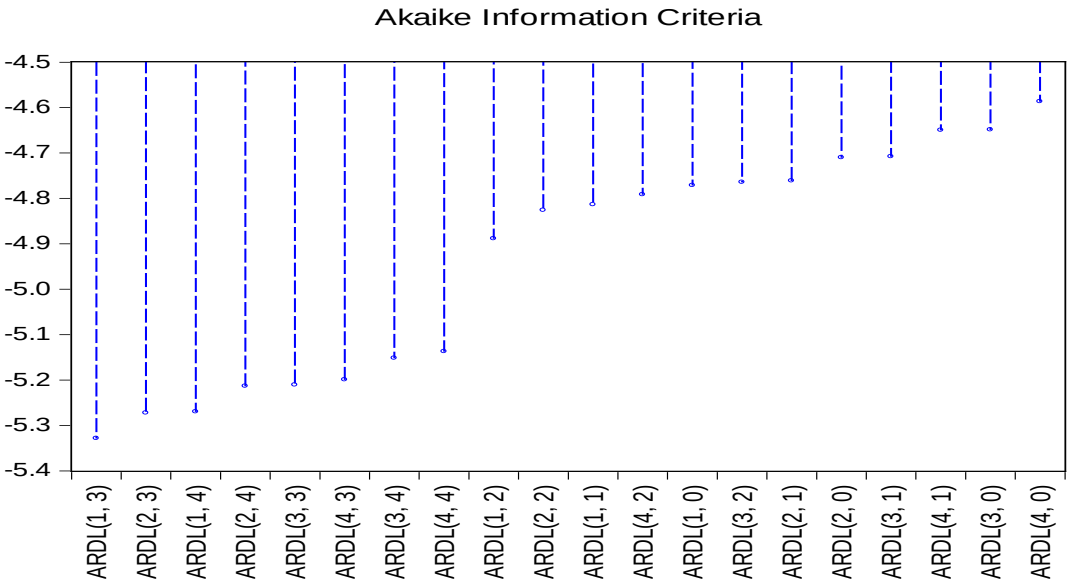
It might be deployment of environment friendly technologies. The population growth and bio capacity has encountered negative consequences for Pakistan environment by putting more intense pressure on bio productive space but it looks like our production based pollution is not only because of growing population. It is openness of trade that has also encouraged Pakistan to produce more to export and hence, it leads to declining ecology of the economy over time. Here the study has observed that scale effect is dominant on technical effects supported by products composition changing over time. This composition in energy mix and inputs during the production process has changed from coal to gas and oil in cement and fertilizer products from 1995 onwards. This has affected the ecological footprints negatively for specific products but overall trend is positive and increasing

Table 6.7 Production Ecological Footprints and Income growth

Dependent Variable: PCPFP Sample (adjusted): 1983 2015Included observations: 33 after adjustments Maximum dependent lags: 4 Automatic selections,				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
PCPFP (-1)	0.195794	0.099634	1.965137	0.0621
PCIGRW	0.947839	0.200392	1.735795	0.0566
PCIGRW (-1)	0.241600	0.171593	1.407984	0.1731
PCIGRW (-2)	0.139507	0.152637	0.913975	0.3706
PCIGRW (-3)	0.460018	0.140763	3.268027	0.0035
PCIGRWSQ	-6.231244	1.742796	-3.575429	0.0017
POPG	0.000128	0.000279	0.460507	0.6497
OTT	1.775405	0.856884	2.071931	0.0502
ENPC	-1.71E-05	0.000160	-0.106930	0.9158
BC	0.330534	0.042087	7.853670	0.0000
C	0.068577	0.075794	0.904783	0.3754
R-squared	0.928804	Mean dependent var		0.701357
Adjusted R-squared	0.896442	S.D. dependent var		0.047323
S.E. of regression	0.015229	Akaike info criterion		5.270054
Sum squared resid	0.005102	Schwarz criterion		4.771218
Log likelihood	97.95589	Hannan-Quinn criter.		5.102211
F-statistic	28.70043	Durbin-Watson stat		1.565038
Prob(F-statistic)	0.000000			

Figure no 6.7 shows that, this model was selected on the base of Akaike information criteria. The grape above tells us, which model and in how many model the current work of piece is brought in lights.

Figure 6.7 Production Footprint Model selection



d) Bound testing for Production Footprints and income growth

The results of joint testing are statistically significant, which indicates to move further for long run and short relationship investigation through ARDL. The F value is greater than upper bond, which means there is expected, a significant relationship between production per capita and income growth of Pakistan over time. But before making any decision, let's move for Co integration form of the relationship among the available set of variables.

Table 6.8 ARDL Bounds Test for Production Footprints

Date: 01/09/17 Time: 01:04, Sample: 1983 2015		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K

F-statistic	48.76801	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84

Table 6.9 shows that, bio capacity and income growth are associated with per capita ecological footprints in short run as well as in long run. Most important is long run relation between variables of interest in our study. These long run coefficients are highly significant and validate EKC type relation between income growth and ecological footprints in production sector of Pakistan. Increasing bio capacity increase the production of goods demanded within the boundaries of Pakistan and the associated environmental pressure. The model specifies a good fit model and acceptance of proposed relationship of the current study.

Table 6.9 Production Footprints and Income growth in ARDL Co integrating and Long Run Form,

Selected Model: ARDL (1, 3)				
Dependent Variable: PCPFP, Date: 01/09/17 Time: 01:07Sample: 1980 2015				
Short run Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PCIGRW)	0.347839	0.200392	1.735795	0.0966
D (PCIGRW (-1))	-0.139507	0.152637	-0.913975	0.3706
D (PCIGRW (-2))	-0.460018	0.140763	-3.268027	0.0035

D(PCIGRWSQ)	-6.231244	1.742796	-3.575429	0.0017
D(POPG)	0.000128	0.000279	0.460507	0.6497
D(OTT)	1.775405	0.856884	2.071931	0.0502
D(ENPC)	-0.000017	0.000160	-0.106930	0.9158
D(BC)	0.330534	0.042087	7.853670	0.0000
CointEq (-1)	-0.804206	0.099634	-8.071611	0.0000
Cointeq = PCPFP - (1.4784*PCIGRW -7.7483*PCIGRWSQ + 0.0002				
*POPG + 2.2076*OTT -0.0000*ENPC + 0.4110*BC + 0.0853)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCIGRW	1.478432	0.415189	3.560863	0.0017
PCIGRWSQ	-7.748320	2.612430	-2.965944	0.0071
POPG	0.000160	0.000340	0.468864	0.6438
OTT	2.207649	1.122022	1.967563	0.0619
ENPC	-0.000021	0.000198	-0.107531	0.9153
BC	0.411006	0.043804	9.382869	0.0000
C	0.085273	0.087272	0.977095	0.3391

e) Exports Footprints and income growth

After studying Pakistan trade across borders in context of environmental pressure imposed and relaxed on available bio productive space, the current research found that Pakistan is exporting minor negative environmental consequences to its trading partners over time. Current Income growth and squared term are not cointegrated with Exporting pollution of Pakistan to other economies. Trade openness is negatively associated with negative environmental pressure. This is because of our high imports as compare to

exports and it is opposite to the concept of negative terms of trade effects. The results indicate that negative environmental consequences of exports were much higher previously but current income growth is not signifying the increasing environmental pressure due to exports of Pakistan. Up behind the certain limits of emissions, some of our foreign consignments were received back, this might also be the reason that our exports are much cleaner as compared to past.

Table 6.10 ARDL Results for Exports Footprints

Dependent Variable: EFP_EXP_PC Method: ARDL Sample (adjusted): 1984 2015 Included observations: 32 after adjustments Model selection method: Akaike info criterion (AIC) Selected Model: ARDL (2, 4, 1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
EFP_EXP_PC (-1)	5.599032	8.175986	0.684814	0.5022
EFP_EXP_PC (-2)	0.884202	0.323219	2.735616	0.0136
PCIGRW	0.023128	0.062619	0.369347	0.7162
PCIGRW (-1)	0.126204	0.066331	1.902644	0.0732
PCIGRW (-2)	-0.007471	0.046536	-0.160547	0.8742
PCIGRW (-3)	0.099101	0.045824	2.162641	0.0443
PCIGRW (-4)	0.050153	0.044524	1.126427	0.2748
PCIGWSQ	-0.802534	0.510357	-1.572495	0.1332
PCIGWSQ (-1)	-1.49.771	0.602146	-2.475761	0.0235

POPG	-0.000232	0.000158	-1.464879	0.1602
SERVICES SHARE	-0.000757	0.000674	-1.123161	0.2761
ENPC	0.001170	6.35E-05	2.677792	0.0154
OTT	-4.938309	8.087365	-0.610620	0.5491
BC	0.016850	0.008235	2.046271	0.0556
R-squared	0.776047	Mean dependent var		0.020937
Adjusted R-squared	0.714304	S.D. dependent var		0.006406
S.E. of regression	0.003979	Akaike info criterion		-7.916160
Sum squared resid	0.000285	Schwarz criterion		-7.274900
Log likelihood	140.6586	Hannan-Quinn criter.		-7.703600
Durbin-Watson stat	1.881560			

The table number 6.11 results show that bound testing value of F statistics is less than the critical bound values, which indicates that we can accept null hypothesis of no long run relationship exits. Also, the ARDL results confirms no long run association between Income Growth and Exports Ecological Footprints.

Table 6.11 Exports Footprints and income growth ARDL Bounds test.

Test, Included observations: 35		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	2.984858	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68

1%	6.84	7.84

6.5 Major Findings and Answers to the Research Questions

Our study found that Per capita ecological footprint of consumption and Income growth is significantly co integrated in long run and also provides the evidences regarding the EKC hypothesis. EKC holds for production footprints and income growth also imports footprints are significant to this kind of relation with economic indicators of current study. However, the consumption and export ecological footprints are portraying slightly a different story. Answering to the given set of research questions, we can say exports footprints are not significantly reallocated by income growth in Pakistan. Exports footprints are more effectively affected due to biocapicity trade openness and energy per capita.

The consumption footprints and production footprints are reallocated due to income growth over the time. And also, these evidences follow long run association over time. The imports products footprints are smaller than footprints of products produced in Pakistan, which is good for us in terms of saving the biological productive space in Pakistan. It means if we produce same products in Pakistan, it will cost us higher resource use and extractions from our reserves. If these products are imported from others on reasonable economic transactions, it’s possible that these products might help Pakistan to increase the welfare of increasing population.

CHAPTER 7

CONCLUSION AND POLICY RECOMMENDATION

7.1 Conclusion

Study has gone through; literature, which suggests diverse evidence for the relationship of Ecological footprints and income growth. Some studies have claimed EKC-type relationships characterized by an inverted U-shaped derived for income and pollution. Some others findings show significant causality between the two indicators or monotonically decreasing or increasing relationships. Yet, differences might arise from estimation methods and/or the characteristics of the data used.

It is not only the income growth but also other economic indicators that might lead to diverging patterns in environmental quality of Pakistan. Yet again our study has provided some evidences of EKC existence in Pakistan for disaggregated analysis through ARDL bound tests and co integrating technique. This study found that exports footprints of Pakistan is quite smaller than the imported footprints, which indicates that Pakistan is not a production pollution driven country but a consumption based pollution driven economy. It has studied the facts that Pollution heaven hypothesis do exists, where the pollution embodied in products is exported to developing countries as the economy goes richer. Pakistan is importing high of its consumption share in total ecological footprints from other countries in form of products. But for Pakistan evidences are supported by ground realities for observable and changing responses from one economic activity (agriculture sector) to another economic activity (industrial sector) from one kind of pollution to other kind of pollution. For example: from coal to oil and gas.

7.2 Policy recommendations

1) Exports to Pakistan should be faced with a choice, to either keep all the money with myself or pay it to hosting economy of my products as a Carbon tariff. We hope that policy makers will impose tariff on high polluting products that Pakistan is importing from other countries, who do not put any price on Carbon emissions in their country. The Tariff on import products will be based on estimated carbon footprints standards of exporting economy.

2) Production Footprints are reallocated by GDP growth, which might be significantly reduced by deployment of environmental friendly technologies and inputs composition changed in the production process of under research products. So, it is required for policy makers and implementers to be aware of, the inputs used in production of commodities and standards of emissions allowed for a frim. It is an urgent requirement for Pakistan, to deploy better environmental friendly technology and impose standards on emissions of products for small medium and large firms through ISO 14000 and 90002 Standards. This will help us in future for free of Carbon tariff exports to any nation,

3) Products with high resource requirements should be imported from countries, with specialization in production of such products, it will help us to save biological productive space of our own economy for future generation. And it will increase our social welfare as of saving the environment and resources.

4) It’s important to reduce the emission of garment making and tinning industries in Pakistan, which are putting higher environmental stress on hosting economy as well as the receiving economies for the products we export.

7.3 Limitations of the study

1) The per unit ecological footprints standards of all the products are not yet available easily, so that's the reason of including selected products of production, consumption and trade
2) The data of distance from port to port was not efficiently organized, distance is the temporary limitation of the study, it might be covered up in working paper if the data was convincing to use.
3) Double counting is a limitation, which do not allow us to include all the products, which are included in consumption basket of consumers in Pakistan

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APPENDICES

Appendix: A

a) Income Growth and Exports

Author and year	Objective	Data Methodology	Findings
Feder (1982) and Balassa(1985)	To examine the role of exports in growth of economy as well as trade and industry progress.	Panel data Error Correction Modelling (ECM	Promising influences of exports on economic growth in developing economies.
Bahmani-Oskooee and Alse (1993)	To find an association between export growth and economic growth for export-led growth hypothesis	Panel data Error Correction Modelling (ECM)	Strong support for export led growth hypothesis for all of the countries included in the sample of nine developing countries
Saqib and Khan (1995)	To find strong indications of bi-directional causation between export growth and economic growth in Pakistan.	Time series Simultaneous equation modelling	Established robust relationship amongst trade performance and economic growth in Pakistan.
Ahmed, et al. (2000)	To investigate the relationship between exports, economic growth and foreign debt for Bangladesh, India, Pakistan, Sri Lanka and four South East Asian countries	Panel data Trivariate causality framework	Rejected the export-led growth hypothesis for all the countries, comprised in the sample, excepting Bangladesh economic growth led by exporting sector.
Aurangzeb (2006)	The relationship between exports and economic growth in Pakistan on time series from 1973 to 2005	Time series	Marginal factor outputs are considerably higher in the export sector
Shirazi and Manap(2005)	The relationship between exports, imports and economic growth for Pakistan for the period from 1960-2003	Time series Long-run causal orderings	There is robust relationship between income growth and trade of Pakistan
Azam and Naeem (2009)	To investigate the export led growth hypothesis and that output growth is the reason of export growth.	Time series two-way causality conversation Co-integration analyses	Domestic investment, FDI, and trade openness had positive effects on economic growth in Pakistan during 1971-2005
Makki and Somwaru (2004)	To find out that the export growth intensifications lead to factor productivity due to advantages gained from increasing returns to scale, by catering to the larger foreign market.	----------	Due to the increase in exports efficiency, the exporters are able to participate in foreign markets, which results in technological developments

			and progression of local industrialists.

b) Studies on EKC testing

Year/Authors	Objective of the study	Data and variables of study	EKC Findings
Sehar-Munir and Azara-Khan (**2014)**	To empirically investigate the environmental Kuznets's curve for Pakistan	Pakistan data from 1980 to 2010 on following variables Co2 and Energy Consumption Trade openness, financial development and industrial value added	The results of the study supported inverse U shaped, Environmental Kuznets's curve in case of Pakistan along with other trade openness and financial-development variables
Muhammad Tariq Mahmood (**2014)**	To investigate the relationship between energy consumption Co2 emission and economy of Pakistan in long run perspective.	Pakistan data from 1973 to 2012 on the following variables. Real GDP, Co2 per capita in tons, fixed capital formation, employed labor force and exports in millions	The study results showed that ECK is not placed in Pakistan in case of these variables and it may not be possible for developing nations as they are on process.
Shebaz (2013)	To find the relationship between economic instability and environmental degradation inside the multivariate frame over the period of 1971–2009 in case of Pakistan	ARDL bound testing approach to co integration for long run and to cover short run dynamics the ECM method was applied.	There existed a long run relationship between both variables and financial instability increases environmental degradation
Shebazet,at al (2015)	To check the empirical evidence of an environmental Kuznets curve (EKC) hypothesis for Portugal from 1971 to 2008	Autoregressive distributed lag bounds testing approach	The evidence of EKC hypothesis in both the short-run and long-run is confirmed.
Tariq Mahmood (2007)	To investigate the long run relationships among the Energy, Environment and the Economy (E-E-E)	Time series data,	We found robust long run relationships between energy, environment and economic growth. It is also found that the capital and labor elasticities of income show decreasing returns in the presence of energy and emission variables

c) Product Environmental Footprint

- ISO 14044: Environmental management -- Life cycle assessment -- Requirements and guidelines
- ISO 14067: carbon footprint of product
- ILCD: International Reference Life Cycle Data System
- Ecological Footprint
- Product and Supply Chain Standards Greenhouse Gas Protocol (WRI/ WBCSD)
- French Environmental Footprint (BPX 30-323)
- UK's Product Carbon footprint (PAS 2050). (Kirana Chomkhamsri, Nathan Pelletier 2011

Appendix B

Few terminologies used in the study

Absorption: Acceptance of a substance/pollution by actuality dissolved in water or as the result of conceivable biochemical reaction with other elements in a plant. Carbon dioxide is e.g. absorbed by the trees and other plants where it responds and creates sugar as well as cellulose and the assertions of oxygen.

Bio-capacity: Bio capacity is given biological productive space to reproduce the resources, used by the community and can absorb the waste generated by the community. In other words the power of area to produce of renewable resources, and absorb the generated waste

Carrying Capacity: Specifies the quantity of animals that are able to nourish themselves on a certain area. On the other hand, the Ecological Footprint point to the area bio

production, which is required to the sustenance of one human being/an anthropological civilization.

Ecological Footprint: The Ecological Footprint for an individual or a group of people is the bio productive area necessary for production of the goods and services consumed and for absorption of generated waste. Since people consume goods and services from all over the world and have an impact on distant places through released waste, the footprint is an area aggregated from many small bio productive spaces. Ecological Footprint s and bio capacities from all over the world are comparable because they are expressed in global average space with global average productivity.

Embodied energy: The energy which is consumed during the manufacture of a product follows it when traded as embodied energy.

Global average area: if all biological production on the Earth (biomass yield per hectare) is divided by the bio productive area, you obtain the global average yield on global average bio productive space. Other concepts used are global average arable land, global average forest land, etc.

Lifecycle analysis: Analysis of material and energy use during the lifecycle of a product from the cradle to the grave, i.e. from raw material production, through manufacturing and use to destruction including operation and transportation.

National Ecological Footprint: Calculation of a national footprint is based on statistics of the total consumption in the country (with corrections for import and export), see above Ecological Footprint and Consumption Division by the number of inhabitants in the country gives an average Ecological Footprint per capita. If the pattern of

consumption is similar all over the country, the national average footprint can be used to calculate the Ecological Footprint of a population in a city, a region, a water catchment area, etc.

Oil equivalents: Oil equivalents demonstrate the amount of oil essential for producing the equivalent quantity of energy as carbon, natural gas, hydropower, nuclear power etc.

Individual product Ecological Footprint: An individual product Ecological Footprint is constructed on data of personal consumption. In certain respects, this may possibly give supplementary precise facts and be more enlightening than a national normal footprint, but it is challenging to include public services (education, medical care, security, etc. which demand put together areas as well as commodities and energy.

Yield factors: A measure of the local biological production in e.g. arable land and forest. The yield depends on climate, soil quality, technology used etc

Fundamental Assumptions of Ecological Footprint Accounting

Ecological Footprint accounting is based on six fundamental assumptions (Wackernagel et al. 2002): The majority of the resources people consume and the wastes they generate can be tracked. Most of these resource and waste flows can be measured in terms of the biologically productive area necessary to maintain flows. Resource and waste flows that cannot be measured are excluded from the assessment, leading to a systematic underestimate of humanity's true Ecological Footprint. By weighting each area in proportion to its bio productivity, different types of areas can be converted into the common unit of global hectares, hectares with world average bio productivity. These two limitations affect the allocation of Ecological Footprint between nations but not the total

global Footprint. The demand on bio capacity resulting from emission of greenhouse gases other than carbon dioxide is not currently included in Ecological Footprint accounts incomplete scientific knowledge about the fate of greenhouse gases other than carbon dioxide makes it difficult to estimate the bio capacity required to neutralize their climate change potential

Appendix C

Results for Order of Integration unit root

Variables	Coefficient	Std. Error	t-Statistic	Prob.	R2	Co-Integration Order
PCIGRW (-1)	-0.435918	0.120368	-3.621562	0.001	.89	Level
EF_CONS_PC (-1)	-0.337937	0.131648	-2.566980	0.015	.66	Level
ECFPPR_PC (-1)	-0.432224	0.136657	-3.162849	0.036	.57	Level
(GDP (-1))	-1.629367	0.434804	-3.747361	0.001	.72	First difference
GDP (-1) ^2	6.484646	0.593987	10.91715	0.011	99	First difference
EF_IMP_GH(-1)	-0.481252	0.151349	-3.179741	0.0453	.64	First difference
TTO	-0.432224	0.136657	-3.22649	0.056	.87	Level
TECH	-1.55367	0.434804	-3.88361	0.031	.92	Level
ENPC	5.574646	0.593987	11.81715	0.028	89	First difference
BIO-capacity	-0.631252	0.151349	-3.167741	0.0353	.84	First difference

Appendix D: RESULTS: VECM FOR PRODUCTION ECOLOGICAL FOOTPRINTS

Vector Error Correction Estimates		
Cointegrating Eq:	CointEq1	
ECFPP_PER_CAPITA (-1)	1.000000	
EN_PC (-1)	-0.000397	
	(0.00032)	
	[-1.24518]	
C	-0.526421	
Error Correction:	D(ECFPP_PER_CAPITA)	D(EN_PC)
CointEq1	-0.757205	-96.70721
	(0.10766)	(41.1093)

	[-7.03348]	[-2.35244]
D (ECFPP_PER_CAPITA (-1))	-0.045760	109.0319
	(0.14265)	(54.4709)
	[-0.32079]	[2.00166]
D (ECFPP_PER_CAPITA (-2))	-0.012994	124.7814
	(0.14380)	(54.9118)
	[-0.09036]	[2.27240]
D (EN_PC (-1))	-0.000382	-0.436280
	(0.00049)	(0.18774)
	[-0.77645]	[-2.32389]
D (EN_PC (-2))	2.41E-05	-0.161040
	(0.00042)	(0.16208)
	[0.05680]	[-0.99359]
C	-0.521018	10.48589
	(0.07004)	(26.7456)
	[-7.43872]	[0.39206]
PCIGRW	-0.309759	311.0907
	(0.28420)	(108.521)
	[-1.08995]	[2.86663]
PCIGW_2	-3.524578	-751.8286
	(2.00758)	(766.603)
	[-1.75563]	[-0.98073]
TECH	-0.003064	-0.305089
	(0.00068)	(0.25874)
	[-4.52124]	[-1.17914]
BIO_CAP_PER_CAPITA	0.404807	7.060487
	(0.05429)	(20.7326)
	[7.45575]	[0.34055]
TRADE_OPENESS	2.516035	-641.1667
	(0.90900)	(347.106)
	[2.76791]	[-1.84718]
INDGRWTH	0.012636	-1.022886
	(0.00339)	(1.29316)
	[3.73132]	[-0.79100]
R-squared	0.826749	0.665056
Adj. R-squared	0.735999	0.489610
Sum sq. resids	0.006069	884.9835
S.E. equation	0.017000	6.491692
F-statistic	9.110160	3.790645

Log likelihood	95.09175	-101.0945
Akaike AIC	-5.035864	6.854211
Schwarz SC	-4.491679	7.398396
Mean dependent	0.000831	4.244918
S.D. dependent	0.033087	9.086710
Determinant resid covariance (dof adj.)		0.011959
Determinant resid covariance		0.004843
Log likelihood		-5.701228
Akaike information criterion		1.921287
Schwarz criterion		3.100353

APPENDIX E: Results: Exports and income growth VECM

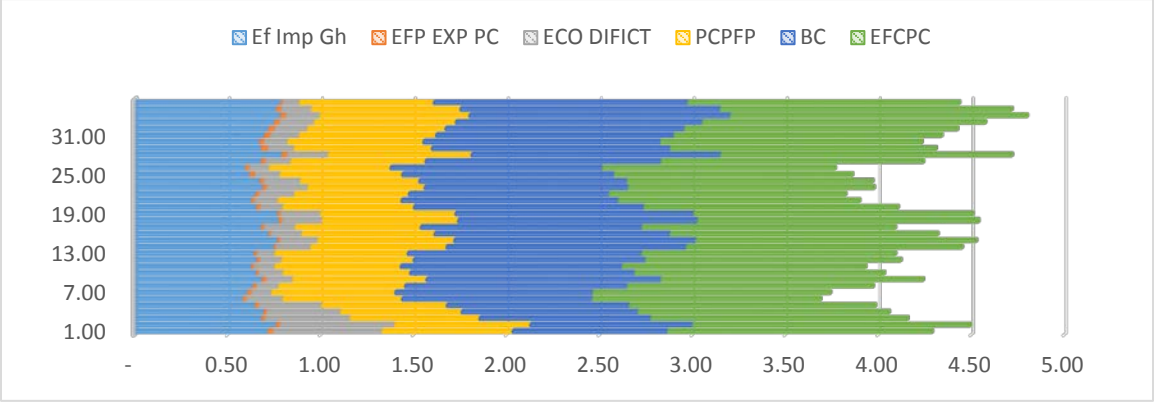
Vector Auto Regression Estimates		
	EFP_EXP_PC	TRADE_OPENESS
EFP_EXP_PC(-1)	0.058726	1.000185
	(0.24153)	(0.00344)
	[0.24314]	[290.640]
EFP_EXP_PC(-2)	0.605941	-0.835156
	(3.93395)	(0.05605)
	[0.15403]	[-14.9002]
TRADE_OPENESS(-1)	-0.401299	0.838102
	(3.84120)	(0.05473)
	[-0.10447]	[15.3138]
TRADE_OPENESS(-2)	0.258053	-0.000461
	(0.20772)	(0.00296)
	[1.24231]	[-0.15572]
PCIGRW	-0.059019	0.000741
	(0.05589)	(0.00080)
	[-1.05589]	[0.93053]
PCIGW_2	0.574111	-0.000186
	(0.38188)	(0.00544)
	[1.50338]	[-0.03413]
TECH	0.000309	-3.42E-06
	(0.00031)	(4.5E-06)
	[0.98438]	[-0.76545]
BIO_CAP_PER_CAPITA	0.001058	5.04E-05
	(0.00298)	(4.2E-05)
	[0.35525]	[1.18848]

INDGRWTH	0.000756	-1.32E-05
	(0.00071)	(1.0E-05)
	[1.06042]	[-1.29893]
R-squared	0.759758	0.999947
Adj. R-squared	0.679678	0.999929
Sum sq. resids	0.000289	5.86E-08
S.E. equation	0.003468	4.94E-05
F-statistic	9.487423	56525.80
Log likelihood	145.3477	285.6359
Akaike AIC	-8.263500	-16.76581
Schwarz SC	-7.855361	-16.35767
Mean dependent	0.021086	0.021442
S.D. dependent	0.006127	0.005874
Determinant resid covariance (dof adj.)		2.92E-14
Determinant resid covariance		1.54E-14
Log likelihood		431.0946
Akaike information criterion		-25.03604
Schwarz criterion		-24.21976

Appendix F:

IMPORTANT VARIABLES	**EF IMP PC GH**	**EFP EXP PC**	**ECO DIFICT PC**	**PC PFP**	**BC PC**	**EFCPC**
MAXIMUM	0.79	0.03	0.61	0.80	1.4	1.5
MEAN	0.69	0.02	0.20	0.70	1.1	1.4
MINIMUM	0.58	0.01	0.08	0.61	0.83	1.2

Appendix G



Appendix H