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An Empirical Analysis of Resource Efficiency and Circular Economy of Pakistan: A CGE Analysis

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ABSTRACT

Resource efficiency and circular economy play a vital role in environmental and economic policy. In this paper we investigated empirical analysis of resource efficiency and circular economy of Pakistan a CGE analysis through GTAP. Resource efficiency and circular economy is normative concept which indicates increase of GDP quantity index, market price index of primary factors, volume of merchandise imports, Industry output, value of gdp, value of global merchandise exports, regional household income through recycling of material circulation and minimization of losses although staying within the limits of natural environment. More resources are being defined as critical which can be imputed to the linear economy of take, make and dispose. An alternative is to fulfil circular economy which could decrease several negative effects between other things resource depletion. Our simulation result of recycling has positive impact in economy of Pakistan. Resource efficiency and circular economy, the role of recycling is beneficial for Pakistan economy.

Keywords: *Recycling, resource efficiency, circular economy, CGE analysis, Pakistan.*

INTRODUCTION

There has been significant interest from policy makers recently towards creating a circular economy and resource efficient future and there appears to be potential to improve the efficiency of how resources are utilized and suggested that potential economic and environmental benefits may arise. Reusing and recycling of materials is fundamental to achieve the sustainable development goals .The concept of circular economy evidence back to different schools of thought. The environmental economists Pearce and Turner, (1989) primarily establish the concept of circular economic system building on previous studies of ecological economist Boulding (1966). Boulding's idea of economy as circular system is seen as a mandatory for the maintenance of the sustainability of human life on earth (a close system with practically no exchanges of matter with the outside environment). From our extensive analysis of literature worldwide the CE concept shows to be rooted in very diverse theoretical background: ecological economics, industrial ecology. Since its very beginning, CE presented itself as an alternative model to the neoclassical economic both from a theoretical and practical point of view as it acknowledges the fundamental role of environment, as well as functions and the interplay between the environment and economic system. Modelling policies to improve resource efficiency and transition to a circular economy

by examining 24 modelling based assessments of circular economy transition (McCarthy et al. 2018). Circular economies are critical for alleviating resources pressure and improving environmental quality at regional level (Liu et al., 2018). Resource efficiency, circular economy and sustainability dynamics in China resource and circular economy offers the bottom up industrial prospective for the sustainability (Welfens et al., 2017). Modeling of the circular economy, designing a global baseline of economic activity and material flow at describing the process to design a business as usual baseline scenario, and deriving the environmental consequences in terms of energy, emissions and material use (Ruben et al. 2017). How different 'product stewardship' and 'end-of-life' strategies support the CE and what the challenges and benefits are from an original equipment manufacturer perspective (Jensen, J.P. 2017). The circular economy is most frequently depicted as a combination of reduce, reuse and recycle activities, whereas it is oftentimes not highlighted that CE necessitates a systemic shift (Julian Kirchherr. 2017). Recycling and waste companies use transportation in their daily operations and a success of their business often depends on the efficient facilitation of entire transport system (Irina Aurdahl. 2016). Circular economy has resource-dependent in developing nations. The industrial revolution led to the modernization of production methods bringing about scientific gain in efficiency (Sijbren et al. 2016). Rethink the concept of the circular economy through the prism of its relevance to its many stakeholders, ranging from public and private actors and mature and emerging industries to cities and regions (Igor Taranic. 2016). A computable general equilibrium approach model which focuses on the circulation of material at every possible stage: extraction, use in production, final consumption, waste generation, waste treatment by landfill or recycling and substitution between primary and secondary material (Alexandre Godzinski. 2015). Circular economy is sustainable development strategy that is being proposed to tackle urgent problems of environmental degradation and resource scarcity. CE's 3R principles are to reduce, reuse and recycle materials (Almas Hesmati 2015). There was a remarkable correlation between circular economic development and GDP (Zhong Taiyang et al. 2015). The paradigm on a circular economy refers to an industrial economy that builds on renewable resources and reduces waste (Rutherford, 2015). The characteristic of resources recycling specially, and to evaluated regional circular economy developing level by the fuzzy comprehensive evaluation method of circular economy development level (Jiang Guogang. 2008). The circular economy's level of implementation, he correlate stakeholders perspectives with drivers, barriers and practices, thus a multi-perspective framework is proposed (Kannan and Mia,2018). The circular economy, networks, organizations, policies, infrastructure and measurable expected effects (Almas, 2018). Evaluation of regional circular economy based on matter element analysis (Jia Chun-ronga and Zhang Jun 2011). A circular economy: insights based on the development of the global ENGAGE-materials model and evidence for iron and steel industry (Matthew Winning et al. 2017). The circular economy position has potential to unleash new wave of operational improvements and batter productivity levels in business and industry (Camilleri, 2017). Effects of CO2 emission trading on steel scrap recycling (Masato Yamazaki 2011). A Circular Economy aims at transforming waste in to resources and on bridging production and consumption activities (Sjors Witjes and Rodrigo Lozano (2016). The life cycle of rare earth elements (REE) is used as a case study to validate the CE core indicators (Elin Akerman, 2016). Recycling plays an important role in the circular economy perspective, it is necessary to radically change the metric used so far to computer the recycling rate (Di Maio, F and Rem P, 2015). Emerging or reiterated main themes in the joint CE literature between EU and china are emergy analysis, indicators; resource efficiency, food waste, zero waste; eco-cities, lifestyle and governance (Serdar et.al 2018).

Objectives

- To trace out the analysis of resource efficiency and circular economy of Pakistan.
- To find out that how recycling of material is fundamental to achieve economic growth.
- To quantify the impact recycling in Pakistan, a CGE model is used.

Global resource efficiency

Resource efficiency explained by the European Commission as boost economic performance while decreasing pressure on natural resources continuously efficient use of them.(EC 2011). It partially respects the sustainability triangle as well as balanced sustainability, primary lacking a social dimension. The impact of resource efficiency on competitiveness as advocated in the Roadmap is empirically evaluated (Florian Flachenecker. 2015). The economic model based upon traditional input/output efficiency may no longer be applicable in the age of global recession (James Yu-Shan Liu. 2012). The global flows of materials and the amounts of materials directly and indirectly necessary to satisfy domestic final demand in different countries world-wide (Stefan Giljum et al (2014). Malaysian manufacturing industry as a whole has an average unified eco-efficiency score of 94% (catagory1) in 2010 which indicates scope for reduction of inputs and pollutants as much as 6% (Noor Asiah Ramli and Susila Munisamy 2015). Plastics waste recycling and the flotation of plastics to concluded the physical characteristics of plastic and plastic waste (Huiting Shent et.al 1999). Resource efficiency and circular economy are measured greatly affects both the ease of acceptance by policymakers and the direction in which green policy will change our society (Francesco et.al (2017).

Resource efficiency in Pakistan

In Pakistan the international finance corporation (IFC) has signed agreement with Gap Inc to boost resource efficiency in its operations and derived sustainability. Under IFC assess the use of resources at the brand's supplier units and help them implement efficient measures to reduce use of water energy and chemicals and other resources. Resource efficiency reduces environmental impact. There is need to reiterate that Pakistan is a still a natural resource based economy. The agriculture sector is a primary employer and most important contributor to economic surplus and principle source of its foreign exchange. (Irfan, 2007). Energy efficiency is measurable quantity. It is the ratio of energy input into a process to energy or work (electricity, heat, transportation) produced by that process. Conservation is use by final consumer is an integral part of energy efficiency of an economy. (Husain, 2010)

Circular economy of world

The circular economy is corrective and regenerative by design and aim to keep products, component, and materials at their excessive utility at value at all times. (Ellen MacArthur Foundation 2016). CE is opposed to linear economy in which material rapidly disposed. The circular economy is "restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times" (Ellen MacArthur Foundation 2016). It is opposed to the "linear economy" in which materials are quickly disposed. The EU action plan for the circular economy describes it as a system "where the value of products, materials, and resources is maintained in the economy for as long as possible, and the generation of waste is minimized". It is considered essential to achieving a "sustainable, low carbon, resource efficient and competitive economy" (EC 2015). Circular Economy (EC) is receiving increasing attention worldwide as a way to overcome the current production and consumption model based on continuous growth and increasing resource throughput (Patrizia Ghisellini et.al (2015). A circular economy in China to serve as a demonstration, beginning at level of enterprises, then industrial parks, then expanding to cities and regions, thus enabling accumulating of experienced to facilitate reasonable decision making at each successive step (Feng Zhijun and Yan Nailing (2007). European commission adopted a circular economy package, which consist of an EU action plan for the circular economy that establishes a concrete programme of action, with measures covering the whole cycle and sets out the timeline when the action will be complete (Daiva Banaite and Tamosiuniene 2016). Information technology and system in china's circular economy: implications for sustainability (Joseph Sarkish and Hanmin ZHU, 2008).

Circular economy of Pakistan

Waste to wealth is book that proves the green and growth. The book examines the new models of circular growth from exploit sustainable resources to the sharing economy. The circular economy model works increasingly well for over customers and for us. (Lacy, P. and J. Rutqvist 2016). The circular debt problem in the Pakistani energy sector. The circular debt problem, sharp adjustments in power tariffs may be required combined with the need by the government to explicitly recognize the cost of power subsidies in the budget (Syed, 2010). In Pakistan recycled materials in different sectors. Recycling is basically the process through which reuse and recover the materials. According to NCS (1996) Pakistan generates 47,290 of solid waste per day, there is open disposable. (Lacy, P. and J. Rutqvist 2016).

METHODOLOGY

It is comprehensively concede that selection of suitable methodology is key step of any research. For the calculation of appropriate consequences while inspecting qualitative a balance methodology is necessary for each research problem. Therefore given study applied well acknowledge methodology with different parts is sectorial aggregation, regional aggregation and the factor aggregation. Second part is which technique we use for estimation which describes the impact of recycling on economy of Pakistan. We have used computable general equilibrium (CGE) for estimation by using GTAP and recycling sectors are paper product and publishing (ppp), chemical rubber and plastic (crp), metal nec (nfm), metal product (fmp).

CGE Modeling

Hertel (1997) explored the data of general equilibrium model and the GTAP in comprehensive explanation. GTAP model considered as a multi-region CGE model and it has construction to cope by comparative static examination of the trade policy reforms. Bohringer and Rutherford (2015) develop a multi-regional CGE model for Ellen MacArthur Foundation (Ellen MacArthur foundation and Mckinsey center for business and environment, 2015) with specific focus on the circular economy.

Theoretical framework

The circular economy is the short for the closing materials cycle and it is a new economic pattern of economy development. The meaning of circular economy is on the character of resource cycle using the resources by a friendly way and combining the environment protecting with economy development. It takes the production of the human being into the process cycle. So the economic activities is the lessen the influence as much possible to the nature (William McDonough and Michael Braungart 2005). The board sense of the circular economy is the social production and reproduction activities enclosing the use of high efficiency resources and environment friendly. It mostly involves the resource saving and using the recycle of scraps and environment protecting. The technical methods are clean production material flow analysis and environment management et al. The aim is to gain the economic benefits and social benefits mostly with the least payment of the nature resource and environment and to implement harmonious development of human societies (Wu Jisong, 2005). The narrow sense of the circular economy is to develop economy by the social production and recycling activities such as reused scraps and recycled scraps. It is equal to the recycling economy or cycle economy (Jisong, 2005).

Empirical framework

Computable general equilibrium (CGE) model which enable global analysis of changes in materials throughout the supply chain and allow us to properly consider the resource efficiency and circular economy impacts of different policy, political and technology futures. In particular we describe the development of modelling capability which can focus in greater detail on the areas of resource extraction,

industrial processes and material recycling, all of which are essential aspects of understanding how to improve the circular economy (Winning, et al. 2017).

Recycling in Pakistan:

According to NCS (1996), Pakistan generates 47,290 tons of solid waste per day, there is open disposable. And open burning of waste while hospital, household and industrial waste is treated as ordinary waste. Not an appropriate analysis about the waste. According to SWM in 2005 annual report, Pakistan recycling has;

- Growth rate 2.4% per year.
- Present estimate is of waste 54,888 tons/ day.
- Rate of generation of waste average from all type of municipal controlled areas varies from 0.283kg/capita/ day.
  Recyclables: 13.6% to 23.55%.

RESULTS AND DISCUSSION

The objective of this research is to investigate the analysis of resource efficiency and circular economy of Pakistan. In case of Pakistan recycling impact check on different variables. We have used computable general equilibrium (CGE) for estimation by using GTAP. The recycling shock is (18.5%) using aggregation scheme (11 by 11).

Table 4.1: Market price index of primary factors, by region

Pfactor	%age change	Pre	Post	Actual change
Pak	16.24	1	1.16	0.16
Oceania	9.98	1	1.1	0.1
EastAsia	9.98	1	1.1	0.1
SEAsia	9.99	1	1.1	0.1
SouthAsia	10.01	1	1.1	0.1
NAmerica	9.97	1	1.1	0.1
LatinAmer	9.98	1	1.1	0.1
EU_28	9.98	1	1.1	0.1
MENA	9.98	1	1.1	0.1
SSA	9.99	1	1.1	0.1
RestofWorld	9.97	1	1.1	0.1

Source: Author's calculation from GTAP

(In the table 4.1) Market price index of primary factors measure the average change in prices by region through recycling. The simulation recycling change shows positive in Pakistan (16.24%) it is much greater impact and pre simulation period of recycling is (1%) and post simulation recycling is (1.16%). All other countries simulation of recycling is showing positive values. It means recycling is positive results on overall economy and economy of Pakistan.

Table 4.2: GDP Quantity Index

Qgdp	%age change	Pre	Post	Actual change
Pak	1.93	213686.2	217808.9	4122.66
Oceania	0	1595230	1595220	-10
EastAsia	0	15220272	15220265	-7
SEAsia	0	2192119	2192111	-8

SouthAsia	0	2091909	2091873	-35.88
NAmerica	0	18490694	18490608	-86
LatinAmer	0	4770430	4770403	-27
EU_28	0	17666264	17666156	-108
MENA	0	3988132	3988128	-4
SSA	0	1460651	1460640	-10.63
RestofWorld	0	3787759	3787741	-17.75

Source: Author's calculation from GTAP

In table 4.2 GDP price index is an indicator for inflation calculated by comparing the current GDP to GDP reference year. At the lowest level of recycling the quantity GDP of Pakistan will increase by (1.93%) and pre simulation outcomes of QGDP was (213686.2 million US$) and the post simulation outcomes of QGDP is (217808.9 million US$) and actual quantitative term is (4122.66 million US$)

Table 4.3: impact of recycling simulations on different macroeconomic variable of Pakistan

variables	% age change	Pre-simulation	Post-simulation	Actual change
Volume of merchandise imports	2.52	56862.29	58294.36	1432.07
Volume of merchandise exports	-10.09	30933.12	27812.51	-3120.61
GDP quantity index	1.93	213686.2	217808.9	4122.66
Market price index of primary factors, by region	16.24	1	1.16	0.16

Source: Author's calculation from GTAP

In the table 4.3 imports of economy play and important role and influence the level of economic growth. After recycling consequently global merchandise imports of Pakistan will increases globally by (2.52%) and pre simulation global merchandise imports was (56862.29%) and post simulation recycling is (58294.36%) the real increases is (1432.07 %).

Table 4.4: Value of gdp

Vgdp	(Sim)
Pak	16.21
Oceania	9.98
EastAsia	9.98
SEAsia	9.99
SouthAsia	10
NAmerica	9.97
LatinAmer	9.98
EU_28	9.98
MENA	9.98
SSA	9.99
RestofWorld	9.97

Source: Author's calculation from GTAP

In the table 4.4 GDP measures the total value of goods and services produced in country. After recycling of goods the countries shows different results of simulation recycling. In Pakistan the value of GDP through recycling increased (16.21%) and positive impact on economy.

Table 4.5: Value of global merchandise exports by commodity

Vxwcom	%age change
Recycling	9.91
GrainsCrops	10.04
MeatLstk	10
Extraction	9.98
ProcFood	10.03
TextWapp	9.99
LightMnfc	9.99
HeavyMnfc	10
Util_Cons	9.96
TransComm	9.99
OthServices	9.99

Source: Author's calculation from GTAP

In the table 4.5 Trough lowest level of recycling export of global merchandise commodity of recycling will increase by (9.91%) its much greater value and positive impact on economy. The export of global merchandise commodity of grain crops will increase by (10.04%). Export of global merchandise commodity of livestock sector will enlarged by (10%). Food extraction sector will enhanced by (9.98%). All other sectors exports of global merchandise commodities has positive impact on economy.

CONCLUSION

This research examines the analysis of resource efficiency and circular economy of Pakistan by using CGE modelling. In case of Pakistan recycling impact check on different variables are GDP quantity indexes, market price index of primary factors, volume of merchandise imports, Industry output, value of gdp, value of global merchandise exports, regional household income. Computable general equilibrium (CGE) model was used for estimation of model results, Recycling sectors used in the study were paper product and publishing (ppp), chemical rubber and plastic (crp), metal nec (nfm), metal product (fmp). The recycling shock was (18.5%). In case of Pakistan through recycling GDP quantity index increases (1.93%) this change shows positive impact on economy of Pakistan. In Pakistan recycled materials in different sectors. Recycling is basically the process through which reuse and recover the materials. The research examined the analysis of resource efficiency and circular economy through impact of recycling a series of simulation scenarios. The methodology framework used for examining recycling impact of Pakistan through the standard GTAP model. Resource efficiency can increase productivity and create economic growth through recycling of materials. The literature studies will serve as a valuable guideline for Govt of Pakistan to force firm to recycle their waste efficiently and make such laws and regulations those are beneficial for the environment. Resource efficiency and circular economy are measured greatly affects both the ease of acceptance by policy makers and the direction in which green policy will change our society. Resource efficiency and circular economy, the role of recycling is beneficial for Pakistan economy. All simulation result shows positive impact on Pakistan. Resource efficiency can increase productivity and create economic growth through recycling of materials.

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