Demand for Energy and Energy Generation: Does Regional Energy Policy Play a Role?

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Abstract

Does regional energy policy play a role in regional energy generation? What does the implication of the current industrialization trend mean for the generation and the supply process across regions? And to what extent does regional energy policy affect energy security (energy supply risks) in regions? This study investigates the effect of regional energy policy on regional generation characteristics in seven regions of the World using regional panel data from 1980 to 2010 a period of 31 years although some years of data are missing. It was found that regional energy policy were been shaped by pollution concerns and that cost reduction needs had strong effects on energy security (energy generation resources supply). The method of estimation used is the quantile regression estimation method which provides robust estimates after controlling for heterscedastic errors and is robust in the presence of outliers in the response measurement. Energy policy has strong implication for access to sustainable supply of energy generation resources however it had little or no effect on energy generation itself. Industrial demand for energy particularly in the developed countries were probably also making developed countries depend on more nuclear and hydro energy generation sources.

Keywords: Kyoto Protocol, Energy Policy, Energy Generation and Generation Sources.

1.0 Introduction

In this section we introduce the topic of discussion. World demand for energy is on the increase particularly with the industrialization drive currently being experienced in emerging economies. For instance from 2016 the United States will no longer be the largest importer of oil from Nigeria since their imports will be overtaken by China[1]. Other issues that bother on consumption patterns such as emissions are also likely to affect regional energy policy.

It is clear that the Kyoto protocol might not be realizable in near future with major energy consuming nations withdrawing from the Doha 2012 round of talks and other circumstance that point to the fact that emissions cut are not likely to be met in the future. Energy generation across regions will be affected by the dwindling availability of fossils as well as drive in improving innovative generative capabilities for cleaner and more sustainable methods of energy production.

Lots of papers e.g. Knox-Hayes, Brown et al (2013), have also tried to address issues of energy demand and supply risk in the generation process. However few have tried to relate specifically the effect of industrial demand for energy on regional specific energy generation and supply. It is also noticeable that industrial energy consumption is on the increase and noticeable industrialization trends in regions mean that this will continue to remain so in the near future[2]. Regions are also highly concerned about cost of each generation source and are likely to continue to diversify their production capabilities to mitigate supply risks Ojeaga, Azuh and Odejimi (2014). For instance the paper Cohen et al 2011 argue for diversification away from fossils due to overdependence stating that one way of risk reduction were probably depending on a variety of energy sources for generational purposes. Cost of generation- can have strong implications for –energy- stakeholders and -policy makers- forcing countries across regions to source for cheaper and sustainable ways to improve generational capabilities EU Green Paper 2001.

The role of regional policy and industrial energy consumption on energy supply and generation remains unclear. The question if countries across regions are actually concerned about industrial demand for energy and the effects

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of regional energy policy on the generation and supply process could offer new insight into how energy stakeholders view the need for providing energy that will meet the increasing demand in countries across regions.

This paper studies the effect of regional policy on energy generation and supply (energy security) across seven regions of the World which include Africa, South East Asia Pacific, Australia, Europe, North America and Latin America. Panel data for regions is used and data is obtained for the period of 1980 to 2010 a period of 31 years although some years of data are missing. The method of estimation used is the quantile regression estimation method which provides robust estimates after controlling for heterscedastic errors in the presence of outliers in the response measurement. The rest of the paper is divided into the scope and objective of study, stylized facts on regional energy policy and generation, literature review, theory and methodological section, sources of data, empirical analysis and results and finally the concluding section.

2.0 Scope and Objective of The Study

In this section we state the scope and objective of the study. The study investigates the effect of regional energy policy (since policy is shaped by energy demand across regions) on energy generation and the energy supply process across regions using a panel of seven regions in the world. It deals extensively on how regional energy policy will shape generation and supply patterns across region noting difference across regions and its implication for the overall supply and generation process across regions. The objectives of the study include;

1. To determine the role of regional energy policy on the energy generation process across regions
2. To examine the extent to which regional energy policy affect energy supply (energy security) across regions.
3. To determine the implications of industrialization trends on energy supply risk mitigation and energy production across regions.

3.0 Stylized Facts on Regional Energy Policy and Generation

In this section stylized facts on energy policy and the generation process are presented for regions under study. Graphs, trends and information are extracted from past studies by Ojeaga, Azuh and Odejimi (2014). The Kyoto protocol aims to cut emissions particularly green house gases emission to the barest minimum. Energy security is measured using score values assigned to regions, based on the level of diversification and regional specific infrastructure in renewable energy sources in regions with North America particularly the

Table 1. World total installed generating capacity by region and country, 2010-2040

	2010	2015	2020	2025	2030	2035	2040	yearly % Δs
		Projections						
OECD								
OECD Americas	**1,248**	**1,316**	**1,324**	**1,379**	**1,456**	**1,546**	**1,669**	**1.0**
United States[a]	1,033	1,080	1,068	1,098	1,147	1,206	1,293	0.8
Canada	137	144	152	163	174	185	198	1.2
Mexico/Chile	78	93	104	118	135	155	177	2.8
OECD Europe	**946**	**1,028**	**1,096**	**1,133**	**1,159**	**1,185**	**1,211**	**0.8**
OECD Asia	**441**	**444**	**473**	**489**	**501**	**516**	**524**	**0.6**
Japan	287	275	293	300	304	309	306	0.2
South Korea	85	93	100	107	114	122	130	1.5
Australia/New Zealand	69	76	81	83	83	85	87	0.8
Total OECD	**2,635**	**2,788**	**2,894**	**3,002**	**3,116**	**3,247**	**3,403**	**0.9**
Non-OECD								
Non-OECD Europe and Eurasia	**408**	**421**	**455**	**480**	**508**	**538**	**563**	**1.1**
Russia	229	239	264	282	299	315	325	1.2
Other	179	182	191	198	209	223	239	1.0

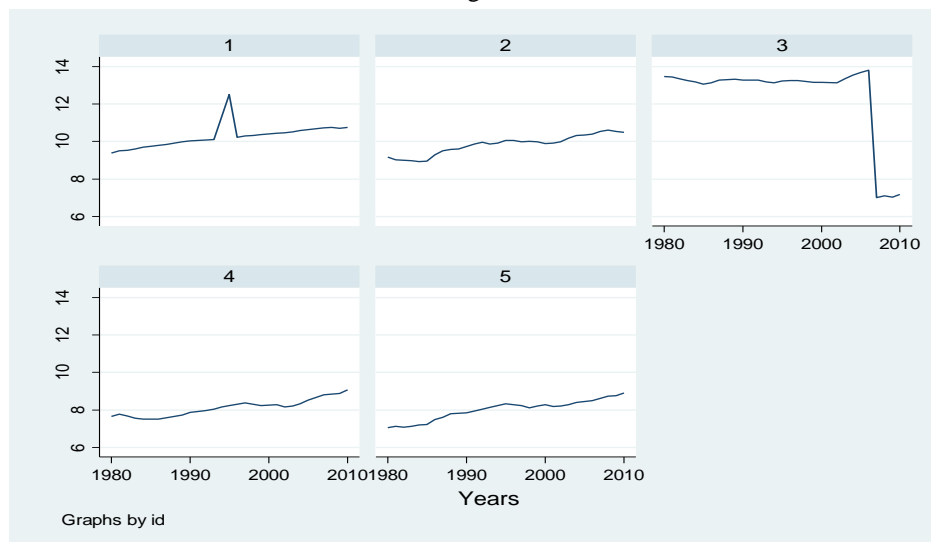|								
Non-OECD Asia	**1,452**	**1,820**	**2,188**	**2,479**	**2,772**	**3,057**	**3,277**	**2.8**
China	988	1,301	1,589	1,804	2,007	2,176	2,265	2.8
India	208	241	285	327	376	440	510	3.0
Other	256	278	314	347	390	441	502	2.3
Middle East	**185**	**197**	**216**	**233**	**247**	**267**	**280**	**1.4**
Africa	**134**	**147**	**164**	**184**	**211**	**244**	**283**	**2.5**
Central and South America	**247**	**279**	**304**	**329**	**362**	**400**	**447**	**2.0**
Brazil	114	137	152	169	191	221	256	2.8
Other	134	142	152	160	171	179	191	1.2
Total Non-OECD	**2,426**	**2,864**	**3,327**	**3,705**	**4,099**	**4,505**	**4,850**	**2.3**
Total World	**5,061**	**5,652**	**6,221**	**6,707**	**7,214**	**7,752**	**8,254**	**1.6**

[a]Includes the 50 states and the District of Columbia.

Note: Totals may not equal sum of components due to independent rounding.
Sources: History: Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2012), www.eia.gov/ies. Projections: EIA, Annual Energy Outlook 2013, DOE/EIA-0383(2013) (Washington, DC: April 2013); AEO2013 National Energy Modeling System, run REF2013.D102312A, www.eia.gov/aeo ; and World Energy Projection System Plus (2013).

United States having stronger capabilities towards averting energy interruptions. Total installed world energy capability appears to be on the increase see table 1 above. This is attributable growing domestic demand for energy and industrialization needs particularly in emerging nations. Data from Data Market of Iceland also show that here is also rapid industrialization in Latin America, South East Asia and other emerging African countries starting in the early 2000s, see graphs 3, 4 and 5 respectively in Fig 3, also means that the competition for the world resources is on the increase despite the slowdown in the industrialization development of the highly developed countries in Europe and North America. See graphs 1 and 2 in Fig. 3. Investment in domestic technology in regions is also ongoing with a steady rate of investment in Europe and North America and continuous improvement for Latin America and Africa. Statistics also show that North America particularly the United States and Canada have some of the largest number of Wind generating plants in the World after China
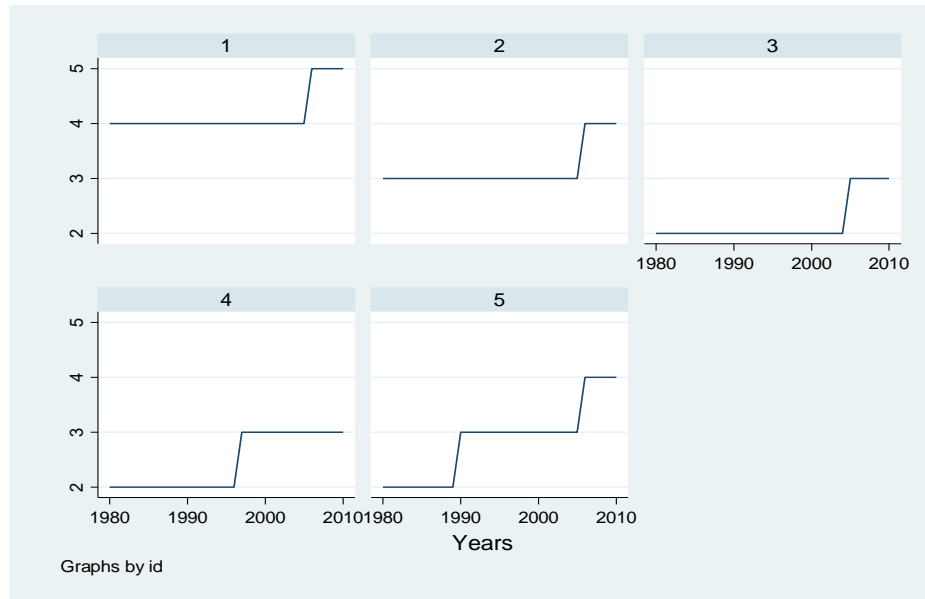
Fig. 1

Graphs by id

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively.

(Renewable Global Status 2006 – 2012 report). Asia is presently experiencing a slowdown from the massive investment of the 1990s in generation technology, but still maintaining steady investment in the development of improved generation sources.
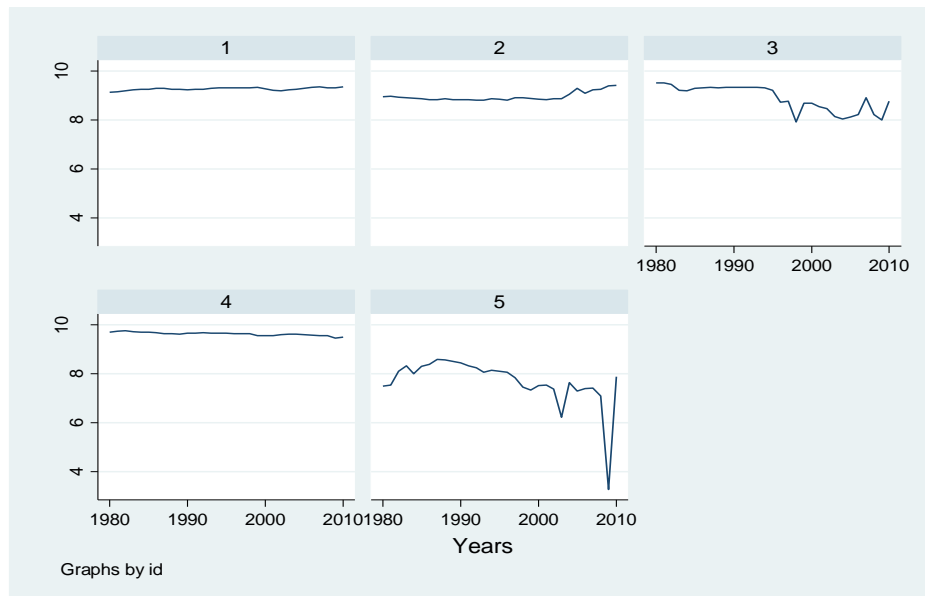
Fig. 2

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively

Statistics show that North America has the most diversified energy sector with the United States having the highest number of wind farms and hydro power stations in the world. Europe is also gradually disengaging from the use of nuclear plants in energy generation and introducing renewable energy technology in the energy generation process although it is still vulnerable to strong dependence on Gas production sources see IEA 2011 report. Hydro production capabilities utilization is still reasonably high for North America, Europe, Africa and Latin America. South East Asia is actually experiencing reduced
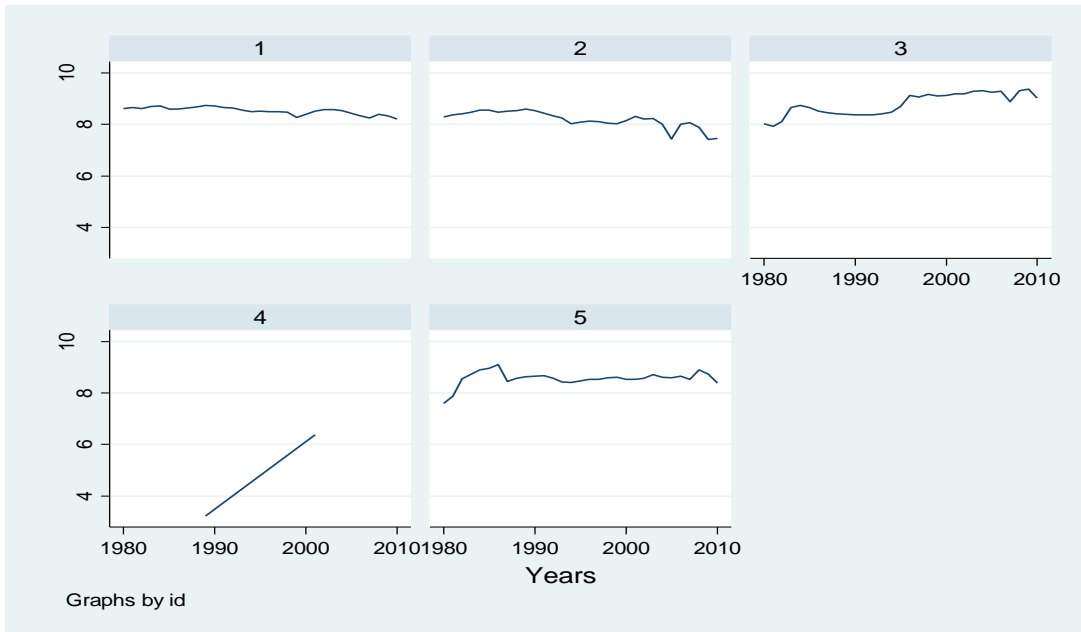
Fig. 3

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively
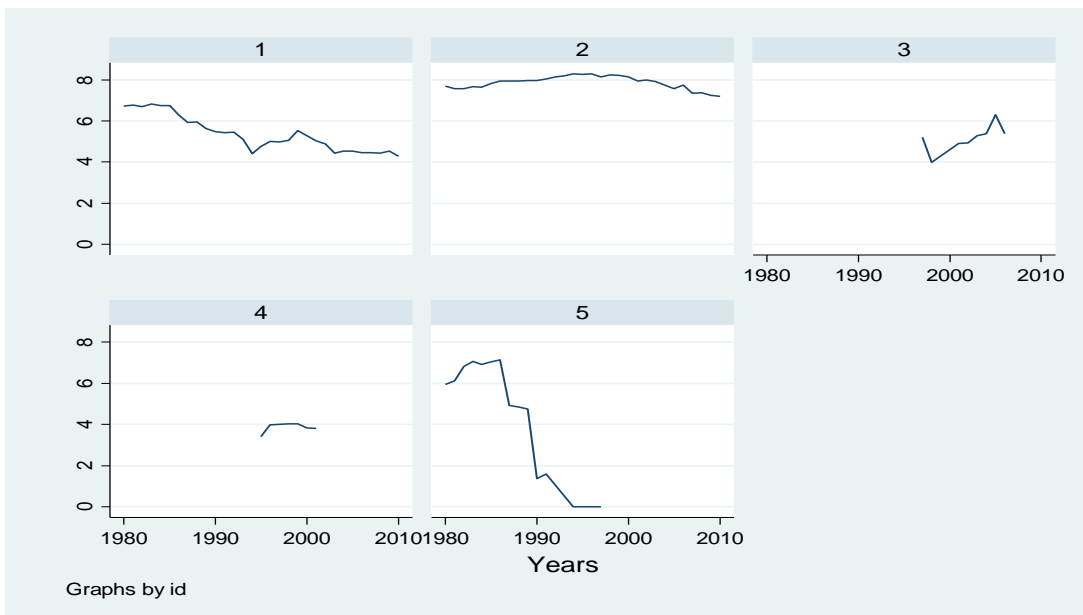
dependence on hydro generation due to probably poor natural sources for developing hydro generation plant capabilities. The use of coal in energy generation is also on the increase for all regions except North America and Europe where a decline in their use are noticeable. This is probably due to the advent of alternative means of generation that are cleaner making these highly developed regions to lack further incentives to continue developing more of such plants for future energy use. Dependence on nuclear generating
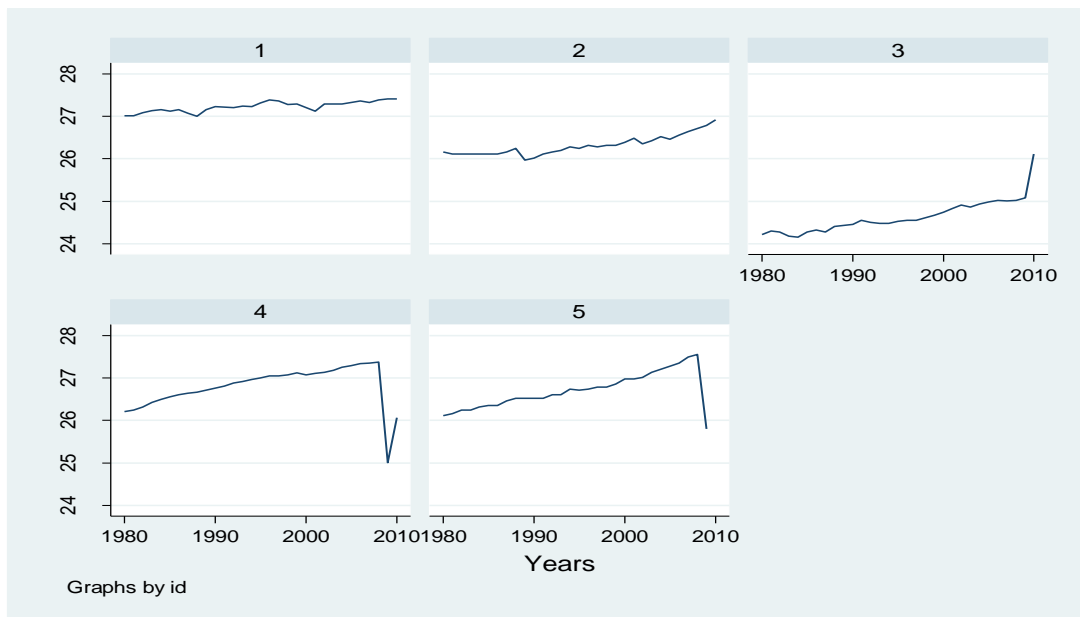
Fig 4

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively
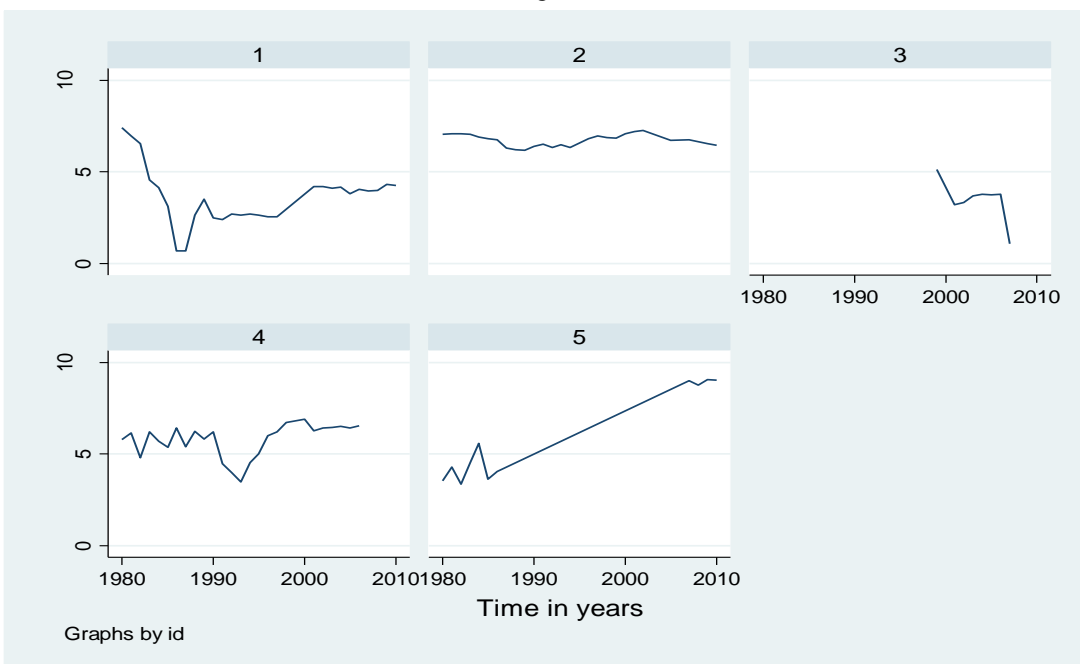
Fig. 5

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively
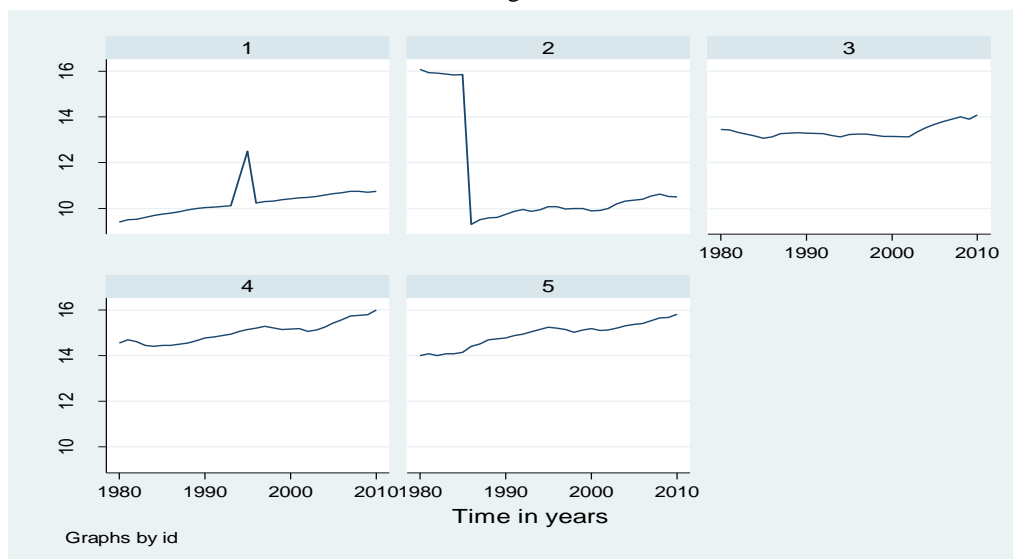
Fig. 6

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively

Fig. 7

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively
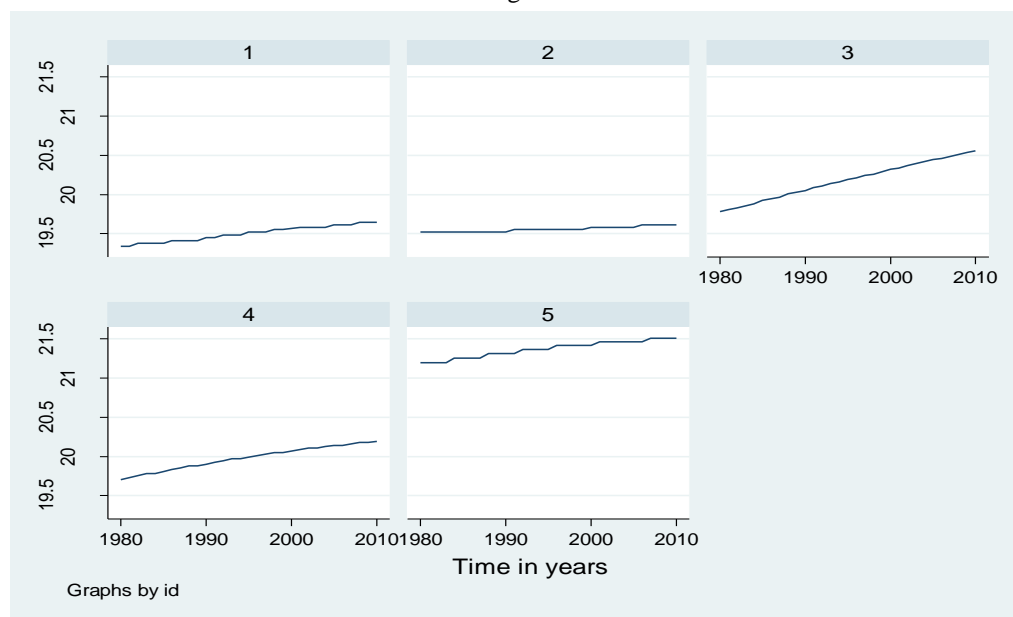
Fig. 8

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively

plants is also on the decrease in all regions except in Africa where only minimal increases were recorded; this is attributable to complexities associated with nuclear waste disposal, cost of maintenance and development and finally the high risk associated with operating such plants, making regions not to have sufficient incentive to develop such generating capacities. Reliance on gas production sources are also on the increase for all regions except for Africa, this is attributable to the relative ease of development of gas plants and access to gas supplies to power such plants.

The use of gas plants in Africa has not experienced commensurate increase compared to other regions due to issues of poor technology and the cost implications of developing such plants since such technologies are often obtained overseas. Energy use in general across regions is on the increase making regions to be vulnerable. Population growth and industrial development in regions continue to exert strain on current generation infrastructure making countries in regions to be constantly engaged in development of more plants and use of cheaper and alternative methods in the generation process. (See Ojeaga, Azuh and Odejimi (2014) for further discussion)

Fig. 9

Note: The graphs above show trends for North America, Europe, Africa, Latin America and South East Asia respectively

3.1 Literature Review

In this section we review some literature related to the topic under study. Ojeaga et al (2014), state that availability of energy resources and access to interruptible energy generation supply is likely to hit Europe most owing to extreme cold winter temperatures and dependence on gas supply from Russia and other external sources.

They reiterate that while energy supply conditions in North America seem to be improving slightly in the 2000s with President Obama's recent approval in 2011/2012 of more drilling rights particularly on the US soil. Facts show that about 19% of the world electricity production comes from renewable energy sources with hydro electricity production alone accounting for about 16% of world electricity production (see International Energy Agency Report 2011).

The IEA Report 2011, mentions environmental constraints, industrialization rate, domestic consumption characteristics and regional specific investment in domestic technology as possible determinants of energy availability across regions.

Lots of literatures also continue to argue for diversification away from fossils due to overdependence (Cohen et al 2011), stating that diversification can lead to sustained supply and mitigate future risk of energy shortage attributable to cost related factors that affect gas supply availability.

Awerbach and Berger (2003) state that the cost in this case determines returns, and that cost are in fact the inverse function of returns, therefore optimizing portfolio cost is not likely to affect results making cost to have no effect on the generating mix.

Coq and Palseva (2004) and Newman (2004, 2007). State that increase in demand are not likely to affect energy security on the short-run since consuming countries are likely to shift to new exporters.

Jansen and Beurskens (2004) also study the impact of portfolio diversity on cost for energy importing countries and state that consumer countries should hold portfolios free of cost risk associated with the hikes in fossil fuel prices.

Knox-Hayes, Brown et al (2013) also attempt to study the effect of cross country energy policy effects on energy security from country specific perspective, to energy vulnerability aversion, they find that energy security is actually been affected by country specific domestic consumption and reliance on specific sources for energy generation.

Investment in domestic technology in regions is also ongoing with a steady rate of investment in Europe and North America and continuous improvement for Latin America and Africa. North America particularly the United States and Canada have some of the largest number of Wind generating plants in the World after China (Renewable Global Status 2006 – 2012 report).

Awerbauch, Stirling, Jansen and Beurskens (2004), define energy security in terms of portfolio diversity and green house gases (GHG) reduction concerns. Ojeaga, Azuh, Odejimi (2014), also state that Kyoto protocol will shape energy policy strategically but has been met with still resistances by the major fossil consumers.

Finally, they measure energy security using country specific signatory and participation in the Kyoto Accord and meeting proceedings, starting from 1998 when the first inter government panels were set up to 2010 when commitment towards emission reduction and implementation plans were emphasized, using score values of 1 to 3 depending on regional level of implementation and finally using consumption patterns in the pre Kyoto protocol years.

4.0 Theory and Methodology

Past theories show that having strong energy mix could substantially reduce supply risk in the energy generation process suggesting that cost is not likely to have any effect on the generating mix, Awerbach and Berger (2003).

Others also suggest that demand increases will not affect energy cost on the short run since consuming countries will seek new exporters Coq and Palseva (2004) and Newman (2004, 2007). Knox-Hayes, Brown et al (2013) explains otherwise stating specifically that energy security (risk of supply disruption) is currently be affected by increasing consumption in countries using a panel of several countries.

In this study we present a case where energy security in countries will depend on several factors, particularly how countries across regions, strategically deploy their scarce resources, to avert supply disruptions. We also consider factors that will affect the generation process since cases of rapid industrialization and improvement in domestic innovation could have cost implications for countries across regions. Factors that also drive dependence on specific generation sources in countries across regions are also examined to ascertain the reasons why particular sources of energy generation are likely to be vital to averting supply disruptions.

Therefore three different model specifications are examined; the first is that energy security will depend on energy policy (POL) in countries across regions, Country and regional size (REG SIZE), energy constraint (ENE CON), industrialization rate (IND RATE), domestic innovation (DOMINV) and finally environmental constraint (ENVCON).

This is likely to be true since policy will affect consumption patterns while cost of transmission will be a function of regional size, energy consumption will depend on domestic demand will be a function of population density while environmental constraint will limit production and increase cost since issues of low temperature during winter will drive up demand and cost and availability of natural resources to generate energy will also be a significant variable for regions.

Energy Security f (POL, REG SIZE, ENECON, INDRATE, DOMINV, ENVCON)

Generation will also be a function of the aforementioned six variables, energy policy (POL) in countries across regions, Country and regional size (REG SIZE), energy constraint (ENE CON), industrialization rate (IND RATE), domestic innovation (DOMINV) and finally environmental constraint (ENVCON). The generation process will be affected by policy through the generating mix. Since countries are likely to depend more on cheaper and relatively easy methods of energy generation.

Renewables (i.e. renewable energy production sources) are likely to be exploited by developed countries that have invested significantly in improving their technical capability in those production sources to mitigate the cost of fossils. The relative cheapness in acquiring such capabilities will also have strategic implication for poor developing countries not endowed with fossils who can gain substantially for other methods of generation.

Generation f (POL, REG SIZE, ENECON, INDRATE, DOMINV, ENVCON)

In the third model the effect of the six variables energy policy (POL) in countries across regions, Country and regional size (REG SIZE), energy constraint (ENE CON), industrialization rate (IND RATE), domestic innovation (DOMINV) and environmental constraint (ENVCON), on the individual generation mix is also considered for five different generation mix;

Generation Sources f (POL, REG SIZE, ENECON, INDRATE, DOMINV, ENVCON)

The likely relevance of this is that energy demand is likely to promote dependence on some specific sources of generation, thus making countries vulnerable to supply threats. While for instance many developed countries will want to face out nuclear reactors in the generating mix, supply threats and growing consumer demand for energy is not likely to make this realizable in the near future. The model specifications are written below as

(1.) $Energy\ Security_{i,t} = \alpha_0 + \alpha_1 POL_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(2.) $Energy\ Generation_{i,t} = \alpha_0 + \alpha_1 POL_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(3.) $Generation\ Source_{i,t} = \alpha_0 + \alpha_1 POL_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

With policy and domestic innovation having positive implication in all three model specifications allowing us to state that they are increasing functions of energy security, energy generation and the individual generating sources $POL_{i,t} \geq 0$ and $DOMINV_{i,t} \geq 0$. While all other variables are a decreasing function of energy security, energy generation and the generation sources $INDRATE_{i,t} \leq 0$, $ENVCON_{i,t} \leq 0$, $REGSIZE_{i,t} \leq 0$ and $ENECON_{i,t} \leq 0$. The method of estimation used in the study is the quantile regression estimation technique. It uses the median as a measure of dispersion instead of the mean. It is based on the intuition that the median of the sample will tend to that

of the population. It provides robust estimate in the presence of outliers in the sample measure particularly the quantile regression wrapper (qreg2) as presented by Machando and Silva (2013). The bootstrapped simultaneous quantile regression estimation also provides the opportunity for re-sampling the dataset and testing the predictive capability of dataset in cases of stringency in the data.

5.0 Sources of Data

All data are obtained from the data market of Iceland and the World Bank unless otherwise stated. Panel data for seven regions were used for a period of 31 years (1980 to 2010). The table below shows all descriptive data used in the study. Three dependent variables are used in the study these are energy security measured using diversification in production capability, energy generation and output generation from five different sources namely hydro, gas, coal, nuclear and renewable energy in kilowatts hour (KWh). The six independent variables used include; **1.)** Energy policy which is measured using score of 1 to 5 for country across regions specific commitment to emission cut, signatory and participation in Kyoto accord **2.)** Energy consumption in kilowatts/hour, this is the aggregate consumption of energy in countries across regions **3.)** Environmental constraint was represented using average regional temperatures since extreme cold temperature could drive up energy demands, **4.)** Domestic innovation was measured using country specific investment in innovation and research and development, **5.)** Industrialization rate was measured using GDP/capita **6.)** Regional size was captured using regional size measured in square kilometers and **7.)** Finally energy consumption which is the total energy consumed across regions in Kilowatts Hours (kWh).

Table-2 Descriptive Statistics Used in the Study

Variable	Observations	Mean	Std. Dev	Min	Max
Energy Security (ENESEC)	155	2.96	0.84	2	5
Total Energy Production in Regions	109	6790000	1260000	3300000	43000000
Production from Hydro Sources	155	8861	4464	26	16960
Production from Gas Sources	125	570	1391	0	8528
Production from Coal Sources	155	4266	2797	0	11750
Nuclear production Sources	155	660	1111.9	0	4006
Production from Renewable Sources	124	3820000	243000	310000000	920000000
Industrialization Rate (INDRATE)	154	1867753	226528.5	10000000	300000000
Energy Policy (POL)	155	1.4	0.57	1	3
Energy Consumption (ENECON)	154	1915535	947609.8	28.8	3300000
Domestic Innovation (DOM. INN)	132	3369.689	1812.66	-4.32	6694
Environmental Constraint (EVNCON)	144	2750.256	30.56	-0.06	16541

Note: Descriptive statistics is derived from author's dataset obtained from data market of Iceland and WDI data of the World Bank.

Table-3. List of Variables and Description

Variables	Sources	Abbreviations	Description
Energy Security	Authors Compilation	ENESEC	Energy security measured using diversification in production capability, energy generation and output generation from five different sources namely hydro, gas, coal, nuclear and renewable energy in kilowatts hour (kWh).
Total Energy Production	Data Market of Iceland	ENEPROD	Aggregate energy production across regions.
Production from Hydro Generation Sources	Data Market of Iceland	HYDROPROD	Production from hydro generation sources in kilowatts hour (kWh)
Production from Coal Generation Sources	Data Market of Iceland	COALPROD	Production from coal generation sources in (kWh)
Production from Gas Generation Sources	Data Market of Iceland	GASPROD	Production from gas generation sources in kilowatts hour (kWh)
Production from Nuclear Generation Sources	Data Market of Iceland	NUCPROD	Production from nuclear generation sources in kilowatts hour (kWh)
Production from Renewable Energy Generation Sources	Data Market of Iceland	RENEWROD	Production from renewable energy generation sources (e.g. wind, biogas, solar etc)in kilowatts hour (kWh)
Environmental Constraint	Data Market of Iceland	ENVCON	Production from hydro generation sources in kilowatts hour (kWh)
Regional Size	Data Market of Iceland	REGSIZE	Regional size in square kilometers
Industrialization Rate	Data Market of Iceland	INDRATE	Industrialization rate measured using GDP per capita.
Domestic Innovation	Data Market of Iceland	DOMINNV	Domestic innovation measured using regional specific investment in research and development.
Energy Consumption	Data Market of Iceland	ENECON	Aggregate consumption of energy across regions in kilowatts hour (kWh)
Energy Policy	Data Market of Iceland	POL	Energy policy was measured using score of 1 to 5 for country across regions specific commitment to emission cut, signatory and participation in Kyoto accord

Note: All data are obtained from Data Market of otherwise stated. Energy security variable is developed by authors.

6.0 Empirical Analysis and Results

In this section we present the intuition behind the study and the results of the three model specification. Regions will continue to strategically deploy their scare resources towards ensuring cheap and readily available energy for both domestic and industrial consumption. Issues of how to curb emissions and climatic challenges will also affect regional consumption patterns. Ensuring uninterruptible supply of energy generating resource will also encourage diversification in regions and in turn shape the development of different production capabilities across regions. Allowing us to state that;

a. Regions will use energy policy to shore up energy security and reduce supply risks by ensuring diversification of the production process.
b. Investing in domestic technology will ensure that cheaper and local resource dependent plants are built.
c. Domestic demand will inform dependence on certain energy generation sources for instance cost implications and rising demand for energy will cause developed regions to depend on nuclear generation sources despite the challenges associated with disposing nuclear waste.
d. The hazard associated with nuclear generation will reduce the dependence on nuclear energy as a generation source.

Results in Table 4 where we show the effect different factors on energy security show that energy policy and domestic innovation (captured using regional specific investment in domestic technology) were having useful effects on energy security across regions.

The results in table 5 also show that regional size was having a negative effect on energy generation while investment in domestic innovation was improving the generation process. The results in Table 6 where we study the effects of different factors on energy security provide interesting and useful insights into different factors that shape the individual sources of generation. Hydro generating sources were affected by regional size and energy consumption significantly which were both promoting regional dependence on hydro generation sources. Industrialization rate was also increasing the use of gas generating plants, since fossils were readily available and the relative cheapness of developing gas plants were also promoting the use of the source. However regional size had a negative effect on gas plants usage, this is attributable to the cost of transportation to gas generating plants.

Energy consumption was also driving dependence on nuclear generation sources while environmental concerns were having a reducing effect on energy use. Investments in domestic technology were continuing to yield results for renewable energy generation sources. This was probably due to the relative cheapness of the sources and the long run environmental friendly characteristics of the source.

The initial objectives of the study are achieved and reviewed below:

1. Regional policy had no significant effect on the generation process.
2. Regional energy policy had strong consequences for the supply process thus were positively mitigating risk of supply and aiding diversification in energy usage.
3. Industrialization rate had negative effects on energy security posing a threat to energy supply and diversification. However the results were not robust since the preferred Qreg2 regression results were not significant.

Table 4. The Effect of Regional Energy policy on Energy Security

Variables	(1) Qreg Energy Security	(2) Qreg2 Energy Security	(3) Sqreg Energy Security	(4) Bsqreg Energy Security
Regional size	-8.77	-8.77	-8.77	-8.77
	(5.08)	(2.68)	(3.83)	(4.10)
Energy Policy	1.28***	1.28***	1.28***	1.28***
	(0.07)	(0.21)	(0.20)	(0.28)
Ind. Rate	-4.40***	-4.40	-4.40	-4.40
	(1.46)	(7.11)	(5.82)	(8.72)
Energy con.	-2.17***	-2.17	-2.17	-2.17
	(3.78)	(2.40)	(2.07)	(1.82)
Dom. Innov.	0.0003***	0.0003***	0.0003**	0.0003**
	(2.05)	(7.08)	(0.0001)	(0.0001)
Env. constraint	-0.0002***	-0.0002**	-0.0002**	-0.0002*
	(9.29)	(6.96)	(5.96)	(7.90)
Year Effect	No	No	No	No
Observations	113	113	113	113
R-squared		0.63		

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. The above result shows the effect of regional policy on energy consumption. Policy has strong effects on mitigating supply risks. Ind rate represents industrialization rate, energy con represents energy consumption, Dom. Innov. represents domestic innovation and Env. Constraint is environmental constraints.

Table 5. The Effect of Energy Policy on Energy Generation

Variables	(1) Qreg Generation	(2) Qreg2 Generation	(3) Sqreg Generation	(4) Bsqreg Generation
Regional Size	-582.78***	-582.78	-582.78	-582.78
	(181.48)	(1.44)	(2.26)	(1.97)
Energy Policy	-1.94	-1.94	-1.94	-1.94
	(2.40)	(5.55)	(3.46)	(4.29)
Ind. Rate	-1.65**	-1.65	-1.65	-1.65
	(6.50)	(3.32)	(4.58)	(3.02)
Energy con.	913.48	913.49	913.49	913.49
	(1.08)	(3.19)	(1.00)	(6.09)
Dom. Innv.	2.17***	2.17	2.17	2.17
	(7.01)	(3.97)	(2.35)	(5.19)
Env. Constraint	2.00	2.00	2.00	2.00
	(2.63)	(1.19)	(8.05)	(6.73)
Year Effect	Yes	No	No	No
Observations	82	82	82	82
R-squared		0.14		

Note: Standard errors in parentheses*** $p<0.01$, ** $p<0.05$, * $p<0.1$. The above results show the effect of energy policy on the overall generation process. Ind. rate represents industrialization rate, energy con represents energy consumption, Dom. Innov. represents domestic innovation and Env. Constraint is environmental constraints.

Table 6. Effect of Regional Policy on Different Generation Sources

Variables	(1) Qreg2 Hydro Sources	(2) Qreg2 Gas Sources	(3) Qreg2 Nuclear Sources	(4) Qreg2 Renewable Sources
Regional size	0.001***	-2.00*	-2.30	-21.91
	(7.90)	(1.14)	(2.27)	(18.47)
Energy policy	1.60	93.5	693.8*	5.83
	(1.54)	(101.8)	(36.8)	(5.93)
Ind. Rate	9.42	5.40**	-0.0002***	4,835
	(0.0002)	(2.51)	(7.48)	(18.03)
Energy Con.	0.003**	2.09	0.0002**	-66.67
	(0.002)	(4.20)	(8.95)	(78.68)
Dom Innv.	0.67	-0.04	-0.17	1.21***
	(0.44)	(0.04)	(0.14)	(4.09)
Env. Constraint	-0.35	0.0002	-0.06**	-2.38
	(0.25)	(0.014)	(0.024)	(1.83)
Year Effect	No	No	Yes	Yes
Observations	112	88	113	112
R-squared	0.24	0.26	0.74	0.42

Note: Standard errors in parentheses*** $p<0.01$, ** $p<0.05$, * $p<0.1$. The above results show the effect of regional policy on the individual generation sources. Ind rate represents industrialization rate, energy con represents energy consumption, Dom. Innov. represents domestic innovation and Env. Constraint is environmental constraints.

7.0 Discussion and Conclusion

The study provides useful incites for policy makers who wish to understand factors that affect energy supply and generation in countries across regions. The results of the study show that energy policies across regions were not having useful implications for the generation process.

Furthermore energy policies were improving the supply process for generation, mitigating the risk of energy availability disruption but were not increasing the generation capacity across regions.

Industrialization trends prove to be faster than regional improvement in production capability. The risk is that developed countries were relying more on gas plants due to the relative cheapness in their acquisition and on nuclear generation sources making these two capabilities to be the mainstay in the generation process in many developed countries.

Renewable energy generation was being improved by increasing investment in domestic innovation. Developed countries were experiencing returns on investment on renewable energy production capabilities with relative increase in renewable energy production. The implication of this is that renewable energy sources were fast becoming popular and could be quite useful in the future.

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