Residential electricity demand dynamics in Uzbekistan

Bahtiyor Eshchanov[*], *Behzod Odilov*[*], *Obid Khakimov*[*]

**Westminster International University in Tashkent*

Abstract

This article provides qualitative results on income and price elasticity of demand on residential electricity. Both long and short run elasticities were estimated using Autoregressive Distributed Lag (ARDL) model from 2000 to 2014. For the first time for Uzbekistan residential equilibrium adjustment factor was estimated. As expected long run elasticities higher than for short run. Finally, new policy option and recommendations were given.

Introduction

As countries develop they become more energy intensive. ExxonMobil (2018) highlights that energy demand in residential and commercial sector in non-OECD and developing countries will grow exponentially and predicting growth of 40% by 2040 at the same time world GDP will double. Moreover, Khanna and Narasimha (2009) predicted 55% growth in primary energy growth by 2030 from which developing countries account for 73%. Major increase in residential energy consumption comes from increase in economic activity and income of the residents. To meet the roaring demand for energy in developing countries supply of the energy must be sufficient. Majority developing countries use hydrocarbon products (coal, natural gas, liquidized natural gas (LNG), oil, etc.) consumption share in hydrocarbon products consisting almost 90% (BP statistics, 2018). Identically, in Uzbekistan's primary energy consumption hydrocarbon products play dominating role specifically 83% was covered by natural gas followed by oil, hydro-electricity and coal energy 8, 6 and 3% correspondingly in 2017 (BP statistics, 2018). Part of primary energy consumption is electricity industry shows the same trends in hydrocarbon usage. Chief Economist of BP Mr. Dale anxiously highlights the fact that current level of electricity generation by fossil fuels over the world is the same as 1998 which leads to assumption that all changes to increase in usage of renewables were offset by new fossil fuel consumptions. Which lead to increase in carbon emission by 1.6% in 2017. To effectively control the emission government should regulate demand towards energy and electricity generation. In this regulation most crucial tools are elasticities primarily income and price elasticities of demand.

In Uzbekistan supply of energy and electricity managed by State joint stock company (SJSC) Uzbekenergo which is government owned Monopoly Company operating in all divisions of

electricity generation, transmission and distribution. In 2017 in accordance with decree of the President of Republic of Uzbekistan JSC "Uzbekgidroenergo" was established to decrease load of Uzbekenergo taking responsibilities for all hydro power plants. In 2018 electricity generation of Uzbekistan was 62.8 Terawatt hours (TWh) from which Uzbekenergo produced almost 90% (56.3 TWh) and Uzbekgidroenergo which is responsible for all hydro power plants (HPP) produced 10% (6.4 TWh) (Kun.uz, 2018). Yet, number of thermal power plant (TPP) is 10 and hydro power plant (HPP) is 37 which creates insight that TPP capacity outperforms HPP. As far as Uzbekistan's most electricity generation comes from TPP its electricity generation heavily depend on natural gas. Utilization percent of natural gas in TPP is 94% (Asian Development Bank, 2016). ADB (2016) critiques that heavily dependence and usage in enormous amounts of natural gas is inefficient due to high opportunity cost from exporting natural gas to other countries. Moreover, Uzbekistan is constructing new atomic power plant and solar PV plant to diversify electricity generation. One of the main driving factor in electricity supply is investments. In accordance with decree of the President of the Republic of Uzbekistan on modernization and diversification of sources of electricity generation Uzbekenergo from 2018 till 2021will realize 52 investment project total amount of 11 billion USD to meet growing electricity demand (Uzbekenergo, 2019). However, de Nooij (2011) analyzing investment projects of "NorNed and the East–West interconnector" found that without analyzing the demand for capacity and electricity it is not worth investing. de Nooij (2011) explains that is because one does not know the benefit of the investment. In Uzbekenergo demand for electricity formulation and projection is made based on population growth yet for Uzbekistan demand for electricity modeling was firstly made by Eshchanov (2011) using panel data for residential consumers and predicted demand applying price of electricity and GRP as predictor of income. In this study we used the same methods but cointegration model, known as autoregressive distributed lag (ARDL).

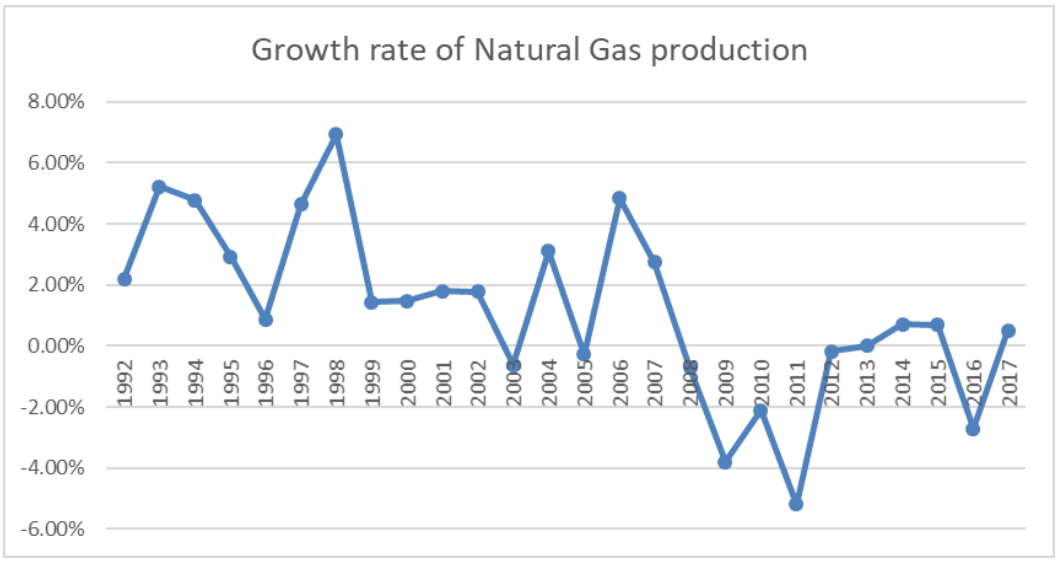
Literature review

Literature review on electricity demand mainly analyzed in three groups: residential, industrial and aggregate. Residential sector mainly uses electricity for household electric devices (TV, light, radio, air conditioner, etc.) for lighting, heating or cooling, and other recreational and study activities. In contrast with in industrial sector which mainly used for producing output. Finally, aggregate group merges both residential and industrial sectors. It is widely used when general overview needed or when data is insufficient about residential and industrial sectors. Another difference between residential and industrial sectors other than usage of electricity is

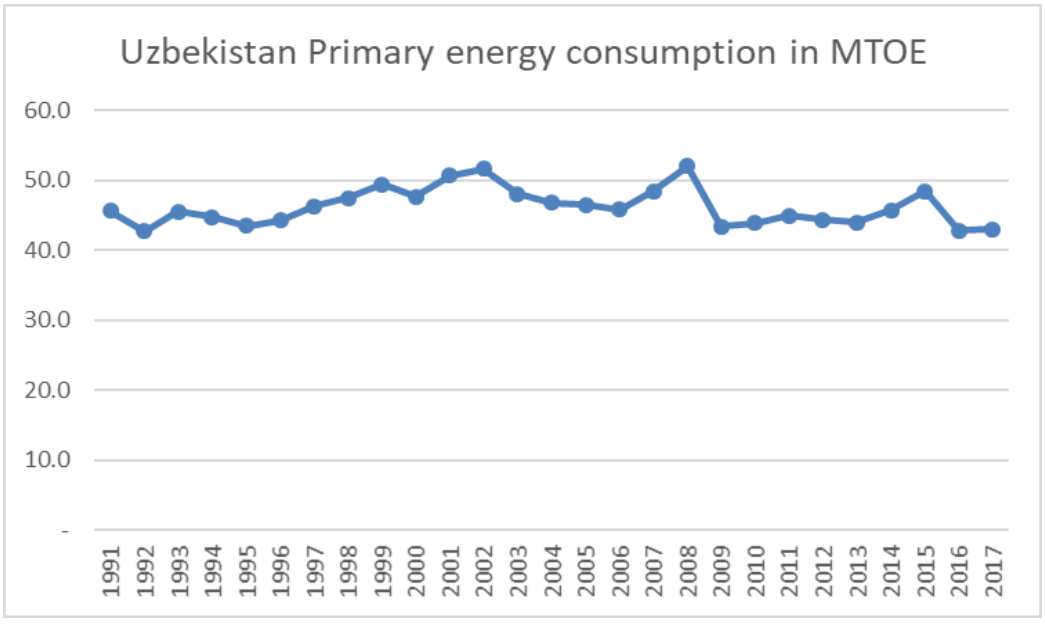
in consumption behavior. As an example Wang and Mogi (2017) found that residential sector in Japan is more sensitive to price changes than industrial sector. Primary difference for residential and industrial electricity consumption sectors in Uzbekistan is their association to different price groups or tariff groups.

Another point to take into account is electricity consumption behavior variation across developing and developed countries. According to Khanna and Rao (2009) majority developing countries face a problem of accessing to electricity in rural areas and this problem depending on the country varies dramatically as an example of rural population who has not access to electricity they give Sub-Saharan Africa ranging from 2-5% while in Mexico on average 85%. Meanwhile, problem of electricity accessibility is rare case for developed countries for both urban and rural population. According to World bank data (2018) accessibility of electricity to population in Uzbekistan is 100%. However, rural population of Uzbekistan still suffering from periodic electricity losses. While, Atakhanova and Howe (2007) claim that in central Asian countries capacity of electricity generation exceeds the demand in countries. This is mainly because most energy generating plants built in soviet era targeting whole nation of USSR. For Uzbekistan capacity usage of hydro power plants is almost 30% while 70% is waiting for its utilization. Total installed electricity capacity in Uzbekistan is 12.6 GW in 2014 while electricity consumption was 1.645 GWh in 2014.

Most literature review on residential energy demand functions in developing and developed countries were conducted using single and multivariate cointegration approach (Halicioglu, 2007). Kenisarin M. and Kenisarin K. (2007) conducted first empirical research using climate and urbanization in Uzbekistan. In their research paper, they highlighted that in Uzbekistan consumption of energy per capita is close to developed countries such as Finland, Switzerland and USA while living standards and climate conditions dramatically differ. Yet on this review by Kenisarin M. and Kenisarin K. (2007) might be outdated the reason for that is until 2006 growth of primary energy production and natural gas production was high but after 2006 growth rate rapidly decline (Graph 1). Moreover, primary energy consumption in Uzbekistan in 2017 also is lower than of 2006 (Graph 2) and comparable countries in terms of per capita energy consumption changed (Table 1).



Graph 1. Growth rate of natural gas production. Source: BP statistics (2018).



Graph 1. Primary energy consumption in Uzbekistan in MTOE. Source: BP statistics (2018).

Countries which Kenisarin M. and Kenisarin K. (2007) as Finland, Switzerland and USA in 2017 dramatically differ than Uzbekistan's primary per capita energy consumption. Nevertheless, in 2017 primary energy consumption per capita is comparable with countries

upper middle income while Uzbekistan is in lower middle income according to World Bank estimates (2017) and living standards correspondingly differ from upper to lower middle income countries.

Table 1. All values for 2017

	GDP per capita (current US$)[1]	Primary energy consumption (MTOE)[2]	Primary energy consumption per capita (TOE)
Norway	75,504.57	47.5	8.98
Finland	45,703.33	27.6	5.00
Czech Republic	20,368.14	41.6	3.93
Switzerland	80,189.70	26.4	3.12
Greece	18,613.42	27.6	2.57
Portugal	21,136.30	26.4	2.56
China	8,826.99	3132.2	2.26
Turkey	10,540.62	157.7	1.95
Argentina	14,401.97	85.9	1.94
Thailand	6,593.82	129.7	1.88
Ukraine	2,639.82	81.9	1.83
Croatia	13,294.51	7.5	1.83
Romania	10,813.72	33.9	1.73
Mexico	8,902.83	189.3	1.47
Azerbaijan	4,131.62	13.9	1.41
Brazil	9,821.41	294.4	1.41
Uzbekistan	**1,504.23**	**43.0**	**1.33**
Iraq	5,165.71	49.2	1.29
Algeria	4,123.39	53.2	1.29
Egypt	2,412.73	91.6	0.94
India	1,939.61	753.7	0.56

1 Source: World Bank data (2018)
2 Source: BP statistics (2018)

Colombia	6,301.59	42.6	0.87
Morocco	3,007.24	19.6	0.55

Furthermore, climate and urbanization level is used in Zachariadis and Pashourtidou (2007) to measure residential electricity demand in Cyprous. In calculation of Namibian electricity, De Vita et al. (2006) used weighted average temperature. Finally, Pesaran et al. (1998) utilized climate and urbanization level for 10 Asian countries. Holtedahl and Joutz (2004) depicts significance of urbanization level in application of government policies but states that if government applies policy pursuing electrifying rural areas urbanization level may not be useful and inconclusive. Halicioglu (2007) describes long run and short run elasticity and they value difference almost by twice which corresponds to other literature review.

Moreover, in all literature reviews, price elasticity is negative and income elasticity is positive which corresponds to basic assumptions of demand to normal goods. However, Halicioglu (2007) found that own price elasticity was -0.52 in long run and explains, “Residential electricity demand cannot be regulated extensively through price policies”. To check “structural breaks” Halicioglu (2007) uses two stage tests firstly visually than through Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). Both visual and econometric tests were statistically significant. One of the important findings of Halicioglu (2007) is error correction term coefficient, which was -0.64 that indicates, “When demand is above its equilibrium level, consumption adjusts by almost two thirds within the first year”. Eshchanov (2011), estimated electricity income and price elasticity for short-run -0.08 and -0.94 respectively.

Data description

In this paper panel data was formed from 2000 to 2014 by districts of Khorezm region. Used variables are total electricity consumption, total population, urban population, rural population, Gross Regional Product (GRP) for Khorezm region and electricity prices for residential consumers.

Data for population growth, urbanization and GRP of Khorezm region was obtained from the state committee of the Republic of Uzbekistan on statistics. Electricity consumption data was used from Eshchanov (2011). For income proxy we took values from the state committee of

the Republic of Uzbekistan on statistics as of 2018 by districts of Khorezm region and was discounted back using GRP growth rate of Khorezm till 2000.