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ENERGY DEMAND MODELING FOR UZBEKISTAN

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Abstract: The paper is devoted to energy demand forecasting in Uzbekistan. Studies show that in spite of the abundant reserves of hydrocarbons, low energy efficiency can have an adverse impact on energy security in Uzbekistan in the future. Oil and gas are the main primary energy source and they ensure energy security of Uzbekistan. Energy demand forecasting is essential in order to develop an effective energy policy. Such forecast can be useful to plan oil and gas production volumes, to identify priorities for the industrial modernization and to create favorable conditions for sustainable economic development in the future. Author proposes model based on translog function for developing medium-and long-term development programs in energy sector and the modernization and technological re-equipment of industry.

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Introduction

Uzbekistan is rich for natural resources and ranks among the leading producers and exporters of natural gas in the world. Oil and gas are the main primary energy sources and they ensure energy security of Uzbekistan. More than 80% of the country's FDI is attracted to oil and gas industry.

At the same time Uzbekistan's economy has very high energy intensity. Like in other CIS countries which inherited its infrastructure from the Soviet Union, the low energy efficiency is typical for all sectors of economy.

Considering the facts mentioned above can abundant resources provide energy security to Uzbekistan? Will investments into energy sector contribute to extensive economic growth? And what kind of priorities in energy sector shall be set up for a long-run term prospect? In our opinion answers for those questions can be offered by energy demand modeling.

Forecast of future energy demand is essential in order to develop an effective energy policy. Such forecast can be useful to plan oil and gas production volumes, to identify priorities for the industrial modernization and to create favorable conditions for sustainable economic development in the future.

Theoretical model

Energy demand modeling has been widely developed in the early 70s of the last century after the world's first "oil shock" (Ryan and Plourde, 2009). Analysis of empirical data led to creation of various methods for energy demand modeling. The experience of industry researchers shows that the forecast must be based on trends in previous years (Bhattacharyya, 2001). Over the past decades, many models have been proposed for energy demand

forecasting, including "bottom up" and "top down" models. Bottom up models study the demand for energy resources at the industries level, while top down models are based on the analysis of macroeconomic indicators (Ryan and Plourde, 2009).

For our survey we chose the second approach because the top down models shied away from including too much technological detail and is focused on economic-inspired relationships (Ryan and Plourde, 2009). We selected translog function because it is widely used for energy demand modeling and its major advantage is flexibility, which permits it to provide a good approximation for the wide range of functional forms that the data can reflect. Proposed model for the energy demand forecasting in Uzbekistan and proof of factors included is the following:

$$lnE = lnP + lnK + lnL + lnE\text{-}1 + \varepsilon, \qquad (1)$$

where E - energy demand, P - energy price, K - capital, L - population, $E\text{-}1$ - energy demand in the previous period, ε - the constant term.

Studies show that changes in the GDP structure have a significant impact on the energy demand. While industrial development leads to increased energy demand, the transition to a postindustrial economy, accompanied by a rapid service sector growth, leads to reduction in energy demand (Kenneth, 2009). At the same time the energy efficient technologies can also lead to reduction in energy demand. Therefore, capital investments are an important factor in our study.

The population along with the industry is a major consumer of energy in Uzbekistan. In a number of papers energy demand researchers discussed the relationship between growth in energy demand and growth of the population (Bettencourt et al., 2007). Authors conducted a number of empirical studies, which confirmed the dependence of energy demand from population levels in such countries like Germany, China and the United States. Thus, the population is an important factor in energy demand analysis.

We consider the price as an important factor in our model, because it impacts on households' energy demand. At the macroeconomic level, the world energy prices influence on governments decisions in the development of energy policy. Despite the fact, that natural gas and petroleum products prices in Uzbekistan are regulated by the government, we have included this factor in our model as world prices may have an impact on the energy export volumes.

Empirical studies

For empirical study we used the data for the period from 1991 to 2009 (BP, 2010; UN, 2010). Dickey-Fuller test showed that time series were non-stationary and using of the least squares method could lead to a "spurious regression". So, we used Engle-Granger test on cointegration. Considering that residuals in the model were stationary, the null hypothesis of no cointegration was rejected and the problem of non-stationary time series was solved and

allowed us to build the desired model of the energy demand. As a result of the regression analysis we obtained the following model:

$$lnE = -0{,}071 * lnP + 0{,}078 * lnK + 1{,}158 * lnL + 0{,}385 * lnE\text{-}1 - 5.938, \quad (2)$$

The value of multiple coefficient of determination R-squared = 0.984 indicates that 98.4% of the total variation explained by the variation of resultant factor variables, we have chosen for the model.

Given that we are considering the model which includes a lagged value (E-1), autocorrelation can lead to failure of regression coefficients and can make the assessment of the least squares inconsistent. We used the Durbin's h-statistic test for autocorrelation analysis, which is calculated based on the regression residuals. This method allowed us to reject the null hypothesis of autocorrelation and found that the regression coefficients are trustworthy.

The coefficients of the model factors are demand elasticities. Based on the model, we can say that a population growth has the greatest impact on energy demand among the factors included in our model. The population growth by 1% leads to an increase in energy demand of approximately 1.16%.

Energy demand forecast

Based on the obtained linear equation and population growth forecast in Uzbekistan (UN, 2008), oil prices forecast (OPEC, 2011) and capital growth forecast (IMF, 2010) we have estimated energy demand in Uzbekistan until 2030 (Table 1).

TABLE 1. ENERGY DEMAND FORECAST IN UZBEKISTAN UNTIL 2030

Years	Energy Demand Forecast, mln t.o.e.	Average Annual growth
2012	65.51	2.76%
2015	71.17	2.79%
2020	81.55	2.76%
2025	90.60	2.13%
2030	99.03	1.80%

Source: Estimated by the author

Table 1 shows us that energy demand will grow substantially in Uzbekistan reaching 99 mtoe in 2030 which is 50% more than it was in 2010. Estimation made by ADB (ADB, 2010) forecasted 54% increase in energy demand between 2005 and 2030. Our results confirm the estimations by industry experts that domestic hydrocarbons will secure Uzbekistan's energy demand for about 20 years (UNDP, 2007).

It should be noted that this forecast does not consider changes in energy consumption structure (e.g. shift to renewable energy resources), as well as

possible energy efficiency improvements. However, our forecast allows us to make the main conclusions regarding future energy demand in Uzbekistan.

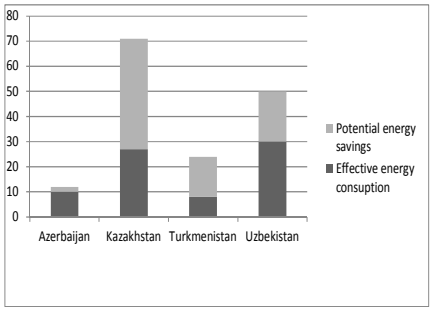
In our opinion, internal factors will have the greatest impact on energy demand growth. Thus, growth of population in Uzbekistan will increase demand for natural gas as a primary source for heating and fuel. Another significant impact on energy demand will have industrial development, which consumes 23% of the total natural gas produced in the country (ADB, 2009). According to the Asian Development Bank, the natural gas will remain the main energy source in Uzbekistan at least until 2035.

External factors, that will have a significant impact on the energy demand growth in Uzbekistan in the medium term, include a possible increase in global demand for natural gas that could change the balance in global energy markets, predicted by experts of the International Energy Agency (IEA, 2011). In particular, the global economic recovery after the recession will affect increased global demand for natural gas. The rapid growth of Chinese and Indian economies with growing demand for global energy will also have a big impact on energy markets in Central Asia.

Discussion

The forecasted increase in energy demand in Uzbekistan along with the depletion of the currently developed fields can adversely affect the energy security of the country. In these circumstances, energy independence can be achieved by increasing the energy production through discovering of new hydrocarbon reserves and by reducing the energy intensity.

FIGURE 1. POTENTIAL ENERGY SAVINGS IN AZERBAIJAN, KAZAKHSTAN, TURKMENISTAN AND UZBEKISTAN



Source: International Energy Agency, 2011

Industry experts estimate that Uzbekistan has a huge potential for energy efficiency improvement (Figure 1). The program of modernization, technical and technological re-equipment of the whole industry sector should play a leading role in reducing domestic energy consumption and lead to accelerating economic growth.

We believe the following policy directions could ensure energy security in Uzbekistan:

- Increasing the hydrocarbon resources base through extensive exploration works in prospective hydrocarbon regions, including involvement of foreign investors in terms of production sharing for newly discovered fields
- Studying the latest R&D achievements in oil and gas industry, exchange with experiences of foreign partners, the acquisition of licenses for the use of unique methods, introduction of modern technologies in oil and gas production, use of secondary and tertiary methods fir exploited deposits to enhance oil and gas recovery
- Cooperation with foreign investors in oil and gas projects that require modern technology and "know-how"
- Development of deep processing of natural gas through cryogenic processes for the extraction of valuable components of the raw material - ethane, propane, butane, etc.
- Implementation of programs to ensure the reliability of gas pipelines, as the main transportation mean of exported natural gas
- Development and implementation of long-term programs to develop oil and gas industry
- Implementation of a whole complex of measures aimed at energy-saving technologies
- Replacement of obsolete and physically worn-out industrial equipment, in line with introduction of modern requirements of energy efficiency
- Development of alternative energy sources.

Conclusion

In our opinion, the proposed energy demand forecasting model can be crucial in developing of medium- and long-term development strategies of oil and gas industry in Uzbekistan. It will also be very useful in the development of an investment program in energy sector in order to create favorable conditions for future development of the country.

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