# *A Dynamic Stochastic General Equilibrium Analysis of Oil Price Shocks: The Case of Bangladesh*

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## Overview

Energy is a vital instrument for economy as it is used in some form almost in every activity. Consequently, analyzing interactions of the energy sector and the overall economy has been the subject of much interest among the researchers. The conventional wisdom is that even though energy does not make up a major fraction of GDP, it plays a crucial role in economy since without energy nothing would be produced. The role of energy is important too on the consumer's side since many types of household products, especially durables are completely energy dependent . The importance of energy in any economy, developed or underdeveloped, also became clear after the first oil shock in 1973 which would have significant impact on the rest of the economy. Those oil shocks questioned the belief of having energy abundances across the world which would not affect the economic growth.

Thus, since the beginning of the 80s, numerous researchers have tried to identify the channels through which such shocks could impact economies. There are different channels of transmission in the literature through which oil price shock can affect macroeconomy (Kilian, 2009). For example higher energy prices are expected to reduce discretionary income, as consumers have less money to spend after paying their energy bills. It also slows economic growth primarily through its effects on consumer spending due to the fall of purchasing power because of inflation. An oil price shock also affects a firm's decision, which results in substitution of oil input in production with capital and labour hiring. The substitution with capital in production affects decisions on the capital accumulation, and this brings along long run effects.

Despite of the wide literature on Dynamic Stochastic General Equilibrium (DSGE) models, to our knowledge there is no model that focuses on a detailed disaggregation of the energy sector. This feature is particularly important for developing countries perspective as energy supply in these countries comes from both private and public energy generating companies and most of the developing countries are now opt for fuel mix options in generating energy to reduce dependency on mono-fuel option. In addition to consider this disaggregation, this paper also asks the question of how the oil price shock would affect macro economy of a small, oil importing developing country.

The model offer richness including household consumption of electricity along with non-electricity oriented consumption and service consumption in the utility function in addition to electricity use at the firm level in industry and service sector. Our model further includes endogenous electricity generating production functions where electricity is produced both publicly and privately for the economy as part of reform process. The basic model is driven by five different shocks: energy price shocks and productivity shocks affects the Industrial output and energy output in three energy generating firms.

In order to obtain quantitative results the usual practice is to calibrate models to a particular economy and we simulate the model for Bangladesh economy to analyze the impulse response functions to productivity and oil price shocks pertinent in Bangladesh economy. Electricity is the most widely used form of energy in Bangladesh. In Bangladesh, about 60 percent of the population currently has access to electricity. However, generating and supplying electricity for the mass people remains and unresolved challenge for Bangladesh and government has implemented significant efforts to increase the electricity generation capacities. The recent improvement in power generation comes largely from the privately owned Quick Rental (QR) power plants which are powered by imported oil. The other responsible authorities for generating electricity in Bangladesh are Bangladesh Power Development Board (BPDB) along with its subsidiaries and privately owned Independent Power Producer (IPP) companies. Both BPDB and IPP use natural gas to generate electricity. A competitive market environment has been created in Bangladesh for electricity generation and recently, nearly 58 percent of total electricity production originates from public sector power plants, whereas the private sector provides the rest 42 percent. Bangladesh Energy Regulatory Commission (BERC) is the responsible authority to fix the electricity prices for all the economic agents in Bangladesh.

## Methods

To find a numerical solution, model calibration is necessary. Hence, the model is calibrated following Kydland and Prescott (1982). The data needed to calibrate the model for Bangladesh economy comes from Bangladesh Bureau of

Statistics (BBS), Bangladesh Economics Review (BER), World Development Indicator (WDI), Bangladesh Labour Force Survey (BLFS), Bangladesh Power Development Board (BPDB), Bangladesh Petroleum Corporation (BPC), Summit Power Limited, Dutch Bangla Power and Associates Limited and Bangladesh Tax Handbook.

Parameter values are specified in different ways. Wherever possible, parameter values are taken from the available data sources. In some cases, the parameters are chosen freely from the literature in that sense they are not implied by the steady state restrictions. The other parameters are obtained by calibration in a way that the real picture of the economy is extrapolated as the steady state trajectory.

We run the program Dynare version 4.4.3, which is a pre-processor and a collection of Matlab routines to solve and simulate the model and to approximate the dynamics of our model economy (See Adjemian et al, 2011 for the methodological details). These routines linearize the system around its deterministic steady state and perform a second order Taylor approximation.

## Results

Our research reveal that higher oil price makes consumption more expensive and reduce consumption, electricity consumption and service consumption through income effect. Since taxes and other prices are fixed, higher world oil price makes government worse off and reduces government transfer. Lower government transfer increases labour supply through income effect which in turn lowers the household wages. Industrial production increases because oil imports are now more expensive and industrial sector needs to produce more exportable goods to keep the trade balance unchanged. Higher oil price also acts as a negative technological shock which causes aggregate capital to reduce initially to prevent household consumption to fall by a large extent. Lower wages coupled with fixed selling prices allows the private electricity generating firms to produce at a cheaper cost. As a result, IPP and QR generation expands as more resources are devoted towards the sectors. Since QR power plants are facing the fixed domestic oil price, they are not affected by the negative consequences of higher oil price. The cost of energy becomes high and accordingly government subsidy increases. Since industrial sector expands, higher currency inflows makes the other sector especially the service sector less competitive and relative price between industry and service sector also declines. Apparently, this can be referred to the "Dutch Disease" in the Economy. Finally, government electricity supply needs to be reduced to equate total supply and demand of electricity since electricity prices are fixed.

## Conclusions

Given our results, it is advisable that policymakers carefully assess the overall welfare effect of oil shocks and when appropriate take some measures to redistribute welfare from industrial sector to the household sector. This is left for future research. Additionally, it would be interesting to see how a equalize electricity tariff for all could affect the household welfare, electricity sector and overall economy in Bangladesh. Another avenue of future research would be to see the welfare effect of flexible electricity price and privation policy in Bangladesh.

## References


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