A Dynamic Stochastic General Equilibrium (DSGE) Analysis of Privatization Impact on Bangladesh Electricity Sector

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INTRODUCTION

- The importance of energy in any economy became clear after the first oil shock in 1973 which would have significant impact on the rest of the economy.

- Bangladesh also considers energy as a prerequisite for her technological, societal and economic growth.
INTRODUCTION

- In almost all reforming countries, electricity reform has been a part of wider policies towards a liberal market economy (Erdogdu, 2010)
- Electricity sector reform has usually involved some combination of product competition, privatization and regulation (Jamasb, 2006; Zhang, et al., 2008).
MAIN RESEARCH QUESTION

- Despite of the extensive literature on Dynamic Stochastic General Equilibrium (DSGE) models, there is no model that focuses on a detailed disaggregation of the energy sector for the mixed economy till now.

- This paper asks the question of how the privatization would affect macro economy of a small, oil importing developing country, like Bangladesh.
THE MODEL

- The model considered in this paper is a DSGE model of a small economy that needs to import oil to generate electricity.
- There are four sectors in the economy:
  1. the production sector
  2. the energy sector
  3. the household sector and
  4. the government sector
THE PRODUCTION SECTOR

- There are three production sectors in the model: a service sector and an industrial sector where final goods are being produced using energy as an additional productive input which is produced in the third sector, the energy sector.

- The representative firm uses labour, capital and electricity to produce the final good of the respective sector.
THE PRODUCTION SECTOR

\[
Y = A^Y_t l^Y_{Y, t} [(1 - \varphi^Y) k^{g - Y}_{Y, t} + \varphi^Y g^g_t]_{v^g g} Y
\]

\[
X = A^X_t l^X_{X, t} [(1 - \varphi^X) k^{s - X}_{X, t} + \varphi^X s^s_t]_{v^s s} X
\]
THE ENERGY SECTOR

- Energy enters in our model as consumption good for households in the form of electricity, as a production of input for industrial and service sectors.

\[
G = A_t^G l_G^{\alpha G} \left[(1-\psi_G)k_G^{-\gamma m,G}_{t} + \psi_G m_G^{-\gamma m,G}_{t}\right]_{\nu m,GG}^G
\]

\[
I = A_t^I l_I^{\alpha I} \left[(1-\psi_I)k_I^{-\gamma m,I}_{t} + \psi_I m_I^{-\gamma m,I}_{t}\right]_{\nu m,II}^I
\]

\[
H = A_t^H l_H^{\alpha H} \left[(1-\psi_H)k_H^{-\gamma h}_{t} + \psi_H h_t^{-\gamma h}\right]_{\nu hh}^H
\]
We further assume that a certain amount of electricity ($\chi$) is lost while transmitting by the distribution companies to the end consumers. So, equilibrium in electricity market:

$$e + s + g = H + I + G - \chi(H + I + G)$$
THE HOUSEHOLD SECTOR

- The representative household maximizes expected utility subject to the following resource constraint:

\[
\max E \sum_{t=0}^{\infty} \beta^t \phi \log \left[ X_t \left( \theta c_t^P + (1-\theta)e_t^P \right) \right] \frac{1-\gamma}{\rho} + (1-\phi) \log(1-l_t)
\]

s.t.

\[
k_{t+1} + c_t + n.X_t + q_t^c.e_t = (1-\tau^l)wl_t + B + (1-\tau^k)rk_t + (1-\delta)k_t
\]
The government, like any other entity in the economy, must satisfy the following resource constraint:

\[ w_l \tau^l + r_k \tau^k + (v^m - \delta^c)(m^I + m^G) + (v^h - v^e)h + p^G.G - r_k G - w_l^G - v^m.mG - B = b \]
THE GOVERNMENT SECTOR

- Total Subsidy is:

\[-b = q^e.e + q^s.s + q^g.g - p^I.I - p^H.H - p^G.G\]

- Combining household resource constraint, government resource constraint and the subsidy equation, the economy wide resource constraint can also be derived.

\[k_{t+1} = Y_t - c_t - v^e.h + (1 - \delta)k_t - \delta^C(m^I + m^G)\]
Our model is driven by five different shocks:

\[
\begin{align*}
\ln v_t^e &= \Omega^Y + \omega \ln v_{t-1}^e + \kappa_t \\
\ln A_t^Y &= \Omega^Y + \mu^Y \ln A_{t-1}^Y + \eta_t^Y \\
\ln A_t^G &= \Omega^G + \mu^G \ln A_{t-1}^G + \eta_t^G \\
\ln A_t^I &= \Omega^I + \mu^I \ln A_{t-1}^I + \eta_t^I \\
\ln A_t^H &= \Omega^H + \mu^H \ln A_{t-1}^H + \eta_t^H
\end{align*}
\]
The model is calibrated for Bangladesh economy following Kydland and Prescott (1982). The dataset is reported in the following table and reflects the variable values in 2011-2012.

### Dataset: Main Model Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q^e$</td>
<td>4.93</td>
</tr>
<tr>
<td>$q^g$</td>
<td>6.95</td>
</tr>
<tr>
<td>$q^s$</td>
<td>9.00</td>
</tr>
<tr>
<td>$p^H$</td>
<td>7.79</td>
</tr>
<tr>
<td>$p^l$</td>
<td>3.20</td>
</tr>
<tr>
<td>$V^m$</td>
<td>.775</td>
</tr>
<tr>
<td>$V^h$</td>
<td>5.72</td>
</tr>
<tr>
<td>$V^e$</td>
<td>8.19</td>
</tr>
<tr>
<td>$\delta^c$</td>
<td>1.1</td>
</tr>
<tr>
<td>$P^G$</td>
<td>2.30</td>
</tr>
</tbody>
</table>
**Dataset, Parameter and Calibration**

Parameter values are reported in the following table:

<table>
<thead>
<tr>
<th>Calibration: Main Model Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta = 0.96 )</td>
</tr>
<tr>
<td>( \psi_H = 0.59 )</td>
</tr>
</tbody>
</table>
We run the program Dynare version 4.4.3 to solve and simulate the model and to approximate the dynamics of our model economy (Adjemian et al, 2011).
MAIN RESULTS FROM THE BENCHMARK MODEL

- Our results reveal that oil price shocks have a negative welfare effect on consumers.

- However, higher oil price makes the country worse off with regard to Terms of Trade (TOT). So, industry expands to produce more exportable goods.
In the privatization experiment, the government should satisfy the following resource constraint:

$$\tau^l \cdot w \cdot l + \tau^k \cdot r \cdot k + (v^m - \delta^C)(m^l + m^G) + (v^h - v^e)h - \tau = b$$
## Main Results

### Table: Percentage Change in SS Values from Policy Experiments

<table>
<thead>
<tr>
<th>Policy Experiment</th>
<th>c</th>
<th>x</th>
<th>y</th>
<th>H+I+G</th>
<th>GDP</th>
<th>h</th>
<th>m¹+m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Privatisation Impact</td>
<td>1.06%</td>
<td>1.90%</td>
<td>0.44%</td>
<td>8.17%</td>
<td>1%</td>
<td>-0.01%</td>
<td>-44.25%</td>
</tr>
</tbody>
</table>

Source: Authors’ own calculation.
CONCLUSIONS

- Given our results, it is advisable that policymakers carefully assess the overall welfare effect of privatizing the electricity sector and take measures to privatize the energy sector.
REFERENCES

THANK YOU FOR YOUR ATTENTION

QUESTIONS?