BANSIM II

Impact of World Oil Price Rise on the Economy of Bangladesh

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Acknowledgement

BANSIM - Bangladesh Simulation Model was developed at NSU with the Syed Abul Basher (now Dr Syed Abul Basher) during his MS thesis in Economics under my supervision. Ever since its first publication the model has gone through significant changes and it was mostly possible due to its modular structure. It had five blocks. In this exercise we have added a new block to capture impact of world oil price change.

This version of the model has been developed with support from the UNDP's REP in Bangkok and the Economic Research Group. The team was lead by me but others involved in various types of activities to update the model particularly because of the Bangladesh's data has changed significantly due to adoption of SNA 1993 method in its national income calculations. It was a tedious work to update all the data and our Research Associate Mashfiqur Rahman Khan (now Lecturer in Economics, Dhaka University) did it very efficiently.

Dr Syed Mainul Ahsan, Advisor to the Governor of Bangladesh Bank and his team (Dr Habibur Rahman and Mr Habibour Rahman) actively participated with us during the discussion while updating the model and provided useful help to link the model rather heuristically with poverty. Dr Sajjad Zohir of Economic Research Group was also active during discussions and provided valuable insights. There were several options to incorporate poverty and world oil prices in the original BANSIM. With some degree of reservations and accepting the limitations in terms of time and resources, we all had to agree to its current form of integration.

At the end of the day, however, I must admit the model served our purpose of providing a reasonably good estimate of the impact of world oil price rise on Bangladesh economy. Our reviewer also did a fantastic job in terms of identifying some logical inconsistencies and which ultimately helped us remove some of the bugs in the model. I remain grateful to all of these persons.

I also remain grateful to Dr Nandita Mongia and Dr. Thiyagarajan Velumail for their support and trust in me in developing this model within a very short period of time.

Dhaka, July 23, 2007 **A.K. Enamul Haque**

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Executive Summary

The study is designed to understand the impact of world oil price changes on the economy of Bangladesh. Following are the major observations.

- The impact of rising world oil prices on the economy of Bangladesh and on the poverty is substantial.
- Five scenarios were developed to understand the impact. In the **baseline scenario** world oil prices are set to remain stable at its 2003 level of around US$ 30 per barrel throughout the period (2005-2020). In the **reduced oil demand (ROD)** scenario world oil prices are set to rise to the current level of US$70 (in 2005) and then falls back to $50 per barrel. In the **business as usual (BAU)** scenario world oil prices were increased to US$70 in 2007 and remained stable at $70 during the entire period. In the **supply shock (SUS) scenario**, world prices of oil has increased to $120 by 2011 and then reduces to $70 per barrel by 2020 and in the **peak oil demand (PKO)** scenario world oil prices gradually increases to $190 per barrel by 2020.
- Compared with the baseline scenario, reduced oil demand scenario reduces GDP of Bangladesh by an average of 5.99% while business as usual scenario reduces it by 7.69%, the supply shock scenario reduces GDP by nearly 7.52% and in case of peak oil demand scenario GDP loss is about 8.97%. These results are for the entire simulation period (2005-2020). During the forecast period the model assumed: agricultural acreage remained constant, growth of vehicles remain fixed at the current rate, all deflators maintain a constant growth rate (of 2005), foreign aid remains constant at the level of 2005 and population increases at the current rate of 1.33%. Consequently, the simulation results would vary if forecasts on these variables are available for 2005-2020 periods.
- In terms of inflation, while the current inflation rate in the model for 2005 is 6.48%, during the entire simulation period, average rate of inflation for the baseline scenario is around 0.65 percent (2005-2020), while under ROD scenario it increases to 4.48%, for BAU it is 4.97%, for SUS it is 8.82 and for PKO it is 6.42%. The model predicts an inflation rate of 8.47 percent in 2007 and the current inflation rate is 8.29 percent. Model also shows that a

sharper rise in world oil prices will lead to more inflationary pressure than a slower increase in prices.

- In terms of hardcore poverty (head count ratio), the 2005 poverty rate in Bangladesh is 22.64%. Under the baseline line scenario it would have dropped to 9.27% by 2020. However, under ROD scenario the percent of hardcore poor will be 10.4% in 2020. This means that nearly 1.89 million people slipped through the net due to oil price increases. Under the BAU scenario (with world oil prices at $70 per barrel), the percent of poor people will be 10.80 meaning about 2.55 million people slipped through the poverty reduction strategies of the government due to oil price increase. Under the supply shock scenario, the number of hardcore poor population will be 2.3 million (a slight improvement when alternative fuel is used to combat oil price increase) and under peak oil demand scenario nearly 3.1 million people will slip through the poverty reduction strategy of the government of Bangladesh due to oil price increase. All these numbers are compared to the baseline scenario.

- Consequently, poverty reduction program of the Bangladesh government will be seriously affected due to oil price increase.

- In terms of fiscal deficit, oil price increase will trigger in several fiscal problems for the government of Bangladesh. First, reduction on income and output will result in budgetary deficits and second since government of Bangladesh maintains an administered price for oil and oil based products the government will be faced with additional burden and the budget deficit will aggravate further.

- This study takes into account of the fiscal problem arising out of fall in income and output. The simulation results suggest that for the entire period of simulation the budget deficit would have been 7.6 percent (of government revenue earnings) if the oil prices are following the baseline scenario. Under the baseline scenario the budget deficit would have turned into a surplus by 2012. But the average overall deficit will increase to 13 percent if the world prices follow the reduced oil demand forecasts. Deficit will further rise to 15.6 percent under BAU scenario. It will further rise to 18 percent under supply shock oil price scenario and will be around 21 percent under peak oil demand oil price scenario. In reality, however,

government will have to make a rather difficult choice and allow increased world oil prices to pass through the system and affect the domestic fuel prices which will further deteriorate the economy with higher inflation and higher poverty rate.

Impact of World Oil Price Rise On the Economy of Bangladesh

Dr. A.K. Enamul Haque

1.0 Introduction

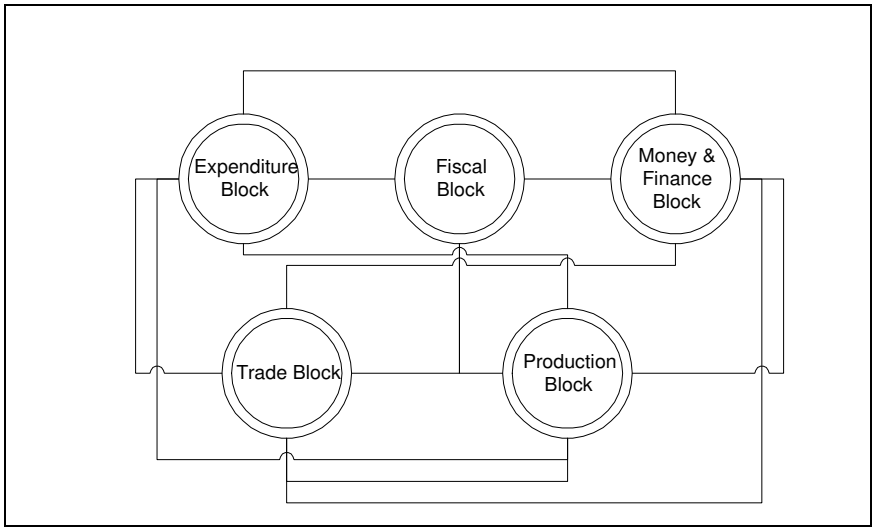
Planners, economists and policy makers have used macroeconomic models for many years to understand changes in the economy due to changes in economic structures. This tool was also used in case of Bangladesh. The first documented case of developing macro-economic models was by Professor Nurul Islam in 1965 for East Pakistan (Islam, 1965). The next model was developed in the World Bank in 1978 but it was not fully developed due to lack of data (World Bank, 1978). Lackman and You (1979) developed another macro economic model for Bangladesh using quarterly data. Then Rashid (1981) estimated another model for short-term analysis of Bangladesh macro economy. In 1988, Haque and Rahman produced an optimal planning model for Bangladesh economy. The next one was developed by Akhtar Hossain (1995) using quarterly data. Rahman and Shilpi (1996) developed a macroeconometric model with five blocks using OLS estimation.

Against this background, Syed Abul Basher (one of my student) developed a Bangladesh Simulation (BANSIM) model in 2000 during his M Sc thesis under my supervision. He estimated the macro-econometric relations for Bangladesh economy using the seemingly unrelated regression (SUR) method, also known as the multivariate regression, or Zellner's method which estimates the parameters of the system, accounting for heteroskedasticity, and contemporaneous correlation in the errors across equations (ref EVIEWS 3.1 help file). It estimates of the cross-equation covariance matrix are based upon parameter estimates of the unweighted system. to estimate the parameters of the model. We call this simulation model as BANSIM I in this document.

BANSIM I had five major blocks of a macro economy: the expenditure block; the fiscal block; the money and finance block; the trade block, and the national income block. The model consists of 26 behavioral equations and 29 definitional identities and 40 exogenous or policy variables. The model includes a set of exogenous variables (mostly policy variables) and set of endogenous variables. Estimates of

elasticities were done at the mid-point of the sample. A schematic view of the structure of the model is given in Figure 1.

Figure 1: Flow chart of the Model



2 BANSIM II – the extended model

After successful implementation of BANSIM I, the author implemented a modification to BANSIM I with a view to capture the impact of oil price change in 2006 and it was developed with help from Dr. Mainul Ahsan (of Economic Research Group), Dr. Habibur Rahman and Mr. Habibour Rahman of Bangladesh Bank and Mr Mashfiqur Rahman Khan of Dhaka University.

The current version of BANSIM I is called BANSIM II as it has added a new block to capture the world price impact on the economy of Bangladesh. The new block in BANSIM II consists of two equations: the price relationship equation and the poverty equation. In the price relationship equation, the CPI is assumed to be linked with world oil prices, exchange rate and the whole-sale price index, and in the second equation poverty is assumed to be linked with GDP of Bangladesh. Both of these equations were estimated using the simultaneous equations model for Bangladesh economy. Since there is no *a priori* theoretical reasons exists to suggest that increase in GDP leads to drop in the rate of poverty in any country, a separate causality test using *Granger's causality test* was used to test the validity of this

hypothesis. The test positively concluded a one-way causal relationship between growth of GDP and poverty rate for Bangladesh data (1981-2995).

Furthermore, the new BANSIM model also amended the production block of BANSIM I with three production function equations for a) agricultural production (include crop, fisheries, forestry and livestock), b) industrial production (all types of industrial output), and c) service sector output. A Cobb-Douglas production functions were specified to estimate these equations.

Re-estimation of the model was done following Zellner's method for a total of 29 equations for the economy of Bangladesh. The model is presented below.

2.1 Expenditure Block

Expenditure is divided into two types: consumption expenditure and investment expenditure and these are the two behavioral equations, which will be estimated in the expenditure block. The estimated results of the expenditure block equations are presented below.

Equation 1: Private Consumption (CONPRI) Function

CONPRI96=175264.216 + 0.078*INCDIS+ 0.799*CONPRI96 (-1)
(4.803)[1] (5.578) (17.914)

R^2=0.992

Where, CONPRI96 is real (with respect to the base year of 1995-96) private consumption expenditure, INCDIS is disposable income.

Equation 2: Private Investment (INVPRI) Function

INVPRI96= 9710.706+0.019*GDP96+1.009*INVPRI96 (-1)- 3136.051*(INTDEP-INFL)
(0.894) (2.221) (21.538) (-3.891)

R^2=0.996

Where, INVPRI96 is real (with respect to the base year of 1995-96) private investment, GDP96 is real (with respect to the base year of 1995-96) gross domestic product, INTDEP is rate of interest of deposits on scheduled banks and INFL is the rate of inflation.

Identities in the Expenditure Block

CONPRI=CONPRI96*CPI96/100
INCDIS=GDPCP-TAXREV
INVPRI=INVPRI96*INVDEF96
INV=INVPRI+ADPEXP
INV96=INV/INVDEF96
SAVN=INCDIS-CONPRI-REVEXP

[1] Value in ( ) is t-statistic.

Where, CONPRI is private consumption expenditure at current prices, CONPRI96 is real (with respect to the base year of 1995-96) private consumption expenditure, CPI96 is consumer price index (with respect to the base year of 1995-96), INCDIS is disposable income, GDPCP gross domestic product at current market price, TAXREV is total tax revenue, INVPRI is private investment at current market price, INVDEF96 is investment deflator (with respect to the base year of 1995-96), INV is total investment at current market price, INVPRI is private investment at current market price, ADPEXP is expenditure for annual development program, INV96 is total real (with respect to the base year of 1995-96) investment, SAVN is total savings, INCDIS is disposable income, CONPRI is total private consumption, and REVEXP is the revenue expenditure of the government.

2.2 Fiscal Block

Equation 3: Income Tax (REVITX)

REVITX= -5089.229+ 0.016*GDPFC
(-8.312) (42.141) R^2=0.962

Where, REVITX is revenue from income tax and GDPFC is gross domestic product at factor cost.

Equation 4: Custom Duty

REVCUS= 7500.797+ 0.099*MPORT
(8.446) (36.407) R^2=0.957

Where, REVCUS is revenue as custom duty and MPORT is total import payment.

Equation 5: Sales Tax and VAT

REVSVAT=-56285.680+0.059*(GDPFC/GDPDEF96)+1326.856*DUMVAT
(-26.999) (42.857) (2.661)
R^2=0.966

Where, REVSVAT is revenue from sales tax and VAT, GDPFC is gross domestic product at factor cost, GDPDEF96 is GDP deflator (with respect to the base year of 1995-96), and DUMVAT is a binary dummy variable for the year 1992 when VAT was introduced.

Equation 6: Revenue from taxes other than income tax, custom duty and sales and VAT

REVOTHX=-4027.496+ 0.024*GDPFC+2799.337*DUM89-3511.979*DUM92
(-4.263) (42.051) (5.592) (-6.712)
R^2=0.977

Where, RERVOTHX is revenue from taxes other than income tax, custom duty and sales and VAT, GDPFC is gross domestic product at factor cost, DUM89 and DUM92 are binary dummy variables for the year of 1989 and 1992 for political depression and formation of new government respectively.

Equation 7: Non-tax Revenue

NTAXREV=-5275.053+ 0.023*GDPFC
(-6.895) (55.694) R^2=0.977

Where, NTAXREV is non-tax revenue and GDPFC is gross domestic product at factor cost.

Equation 8: Revenue Expenditure

REVEXP=-11347.403+ 0.563*GREV+0.036*GDPFC (-1)
(-5.421) (15.262) (7.078) R^2=0.989

Where, REVEXP is total revenue expenditure by the government, GREV is total revenue of the government, and GDPFC (-1) is gross domestic product at factor cost at a one-year lag.

Equation 9: Development Expenditure

ADPEXP=-1111.090+ 0.015*GDPFC+0.196*TTGDEBT+1.469*ADPPA
(-0.639) (6.910) (11.143) (23.36)
R^2=0.981

Where, ADPEXP is expenditure for annual development program, GDPFC is gross domestic product at factor cost, TTGDEBT is total government debt, and ADPPA is project aid in annual development program.

Equation 10: Total Government Debt

TTGDEBT=-31020.017 - 1.833*GDEF
(-5.460) (-32.105) R^2=0.795

Where, TTGDEBT is total government debt and GDEF is budget deficit.

Identities in the Fiscal Block

INDTX=TAXREV-REVITX
TAXREV=REVITX+REVCUS+REVSVAT+REVOTHX
GREV=TAXREV+NTAXREV
GEXP=REVEXP+ADPEXP
GDEF=GREV-GEXP

Where, INDTX is total indirect tax, TAXREV is total revenue from tax, REVITX is revenue from income tax, REVCUS is revenue as custom duty, REVSVAT is revenue from sales tax and VAT, RERVOTHX is revenue from taxes other than income tax, custom duty and sales and VAT, GREV is total revenue of the government, NTAXREV is non-tax revenue, GEXP is total government expenditure, REVEXP is total revenue expenditure by the government, ADPEXP is expenditure for annual development program, and GDEF is budget deficit.

2.3 Monetary Block

Equation 11: Demand Deposit

DEMDEP/CPI96 = 569.640 -30.652*(INTDEP-INFL)+ $9.639*10^{-6}$ GDP96+
(13.011) (-10.553) (0.246)

0.005*DEMDEP (-1)
(10.156) R^2=0.997

Where, DEMDEP is demand deposit, INTDEP is rate of interest of deposits on scheduled banks, INFL is the rate of inflation, GDP96 is real (with respect to the base year of 1995-96) gross domestic product, CPI96 is consumer price index (with respect to the base year of 1995-96).

Equation 12: Time Deposit

TIMDEP=(-1033.247+57.937*(INTDEP-INFL)+0.001*GDP96+0.958*TIMDEP96 (-1))*CPI96
(-9.746) (8.254) (8.629) (56.652)

R^2=0.999

Where, TIMDEP is time deposit, INTDEP is rate of interest of deposits on scheduled banks, INFL is the rate of inflation, GDP96 is real (with respect to the base year of 1995-96) gross domestic product, CPI96 is consumer price index (with respect to the base year of 1995-96).

Equation 13: Net Foreign Asset

NFA=-9853.125+0.694*CAB+726.503*XCHRAT+0.898*NFA (-1)
(-2.413) (28.84) (5.968) (40.017) R^2=0.974

Where, NFA is net foreign asset, CAB is current account balance, and XCHRAT is exchange rate.

Equation 14: Domestic Credit from Scheduled Banks

CRDSB=-37284.820+1.366*INV-2382.0002*(INTDEP-INFL)
(-2.371) (89.835) (-1.138) R^2=0.993

Where, CRDSB is domestic credit from scheduled banks, INV is total investment at current market price, INTDEP is rate of interest of deposits on scheduled banks, and INFL is the rate of inflation.

Equation 15: Domestic Credit from Bangladesh Bank

CRDBB=-908.471-1.445*GDEF
(-0.223) (-27.54) R^2=0.843

Where, CRDBB is domestic credit from Bangladesh Bank and GDEF is budget deficit.

Equation 16: Money Demand Function

LOG (M2R)=-14.665+1.938*LOG (GDP96)-0.009*(DEPRATE-INFL)
(-27.51) (53.076) (-3.294) R^2=0.987

Where, M2R is real supply of broad money, GDP96 is real (with respect to the base year of 1995-96) gross domestic product, DEPRATE is rate of interest of 6 monthly deposit schemes, and INFL is the rate of inflation.

Identities in the Monetary Block

DEMDEP96=DEMDEP/CPI96
TIMDEP96=TIMDEP/CPI96
INFL=(CPI96-CPI96 (-1))/CPI96(-1)
CUROB=M2-TIMDEP-DEMDEP
M1=CUROB+DEMDEP
M2=M1+TIMDEP

Where, DEMDEP96 is real (with respect to the base year of 1995-96) demand for deposit, DEMDEP is demand deposit, CPI96 is consumer price index (with respect to the base year of 1995-96), TIMDEP96 is real (with respect to the base year of 1995-96) demand for time deposits, TIMDEP is time deposit, CPI96 is consumer price index (with respect to the base year of 1995-96), INFL is the rate of inflation, CUROB is currency in circulation, M1 is narrow money, and M2 is broad money.

2.4 Trade Block

Equation 17: Export of Cash Products

XCASH=(347.832+0.0002*AGRVA96-1.855*WAP96-165.408*DUM88)*XDEFL96
(14.66) (2.975) (-6.108) (-19.369)
R^2=0.903

Where, XCASH is export of cash products, AGRVA96 is value added in agriculture at constant prices (with respect to the base year of 1995-96), WAP96 is wholesale price index of agricultural products (with respect to the base year of 1995-96), DUM88 is a dummy variable to capture the impact of the flood in 1988, XDEFL96 is export deflator (with respect to the base year of 1995-96).

Equation 18: Export of Readymade Garments

XRGAR=(249.522+35.983*XCHRAT+0.585*(MINTGOOD/MDEFL96)
(1.527) (20.319) (22.154)
-1568.765*(XDEFL96/MDEFL96))*XDEFL96
(-12.611) R^2=0.99

Where, XRGAR is export of readymade garments, XCHRAT is exchange rate, MINTGOOD is import of intermediate goods, MDEFL96 is import deflator, and XDEFL96 is export deflator.

Equation 19: Export of Goods Other than Cash Products and Readymade Garments

XOTHRS=(-659.150+0.001*GDP96+128.837*CPI96/XCHRAT-6.861*WAP96)*XDEFL96

(-11.643) (32.621) (3.395) (-8.394) R^2=0.99

Where, XOTHRS is export of goods other than cash products and readymade garments, GDP96 is real (with respect to the base year of 1995-96) gross domestic product, CPI96 is consumer price index (with respect to the base year of 1995-96), XCHRAT is exchange rate, WAP96 is wholesale price index of agricultural products (with respect to the base year of 1995-96), and XDEFL96 is export deflator.

Equation 20: Import of Consumer Goods

MCONS=(-163.861+0.0002*GDP96+938.572*INFL-2.901*XCHRAT)*MDEFL96
(-5.775) (5.606) (12.467) (-1.755)
R^2=0.799

Where, MCONS is import of consumer goods, GDP96 is real (with respect to the base year of 1995-96) gross domestic product, INFL is inflation rate, XCHRAT is exchange rate, and MDEFL96 is import deflator.

Equation 21: Import of Intermediate goods

MINTGOOD=-15.502+0.0004*INV96+0.612*(XPORT/XDEFL96)
(-0.289) (1.590) (13.967)
- 567.195*DUM9905)*MDEFL96
(-21.523) R^2=0.969

Where, MINTGOOD is import of intermediate goods, INV96 is real (with respect to the base year of 1995-96) investment, XPORT is total export payment, XDEFL96 is export deflator, DUM9905 is a dummy variable to capture the effect, if any, of the change in the data collection structure of import by the Bangladesh Bank, and MDEFL96 is import deflator.

Equation 22: Import of Oil

MOIL=(-72.620-9.020*CPI96+0.0003*GNP96+0.003*VEHICLE)*MDEFL96
(-1.715) (-13.788) (8.054) (5.469) R^2=0.92

Where, MOIL is import of crude oil and petroleum products, CPI96 is consumer price index (with respect to the base year of 1995-96), GNP96 is real (with respect to the base year of 1995-96) gross national product, VEHICLE is the total number of vehicle, and MDEFL96 is import deflator.

Equation 23: Import of Goods Other Than Consumer Goods, Intermediate Goods, and Oil

MOTHRS=(16.576+0.220*(XPORT/XDEFL96)+0.0005*GNP96+0.241*XCHRAT)*MDEFL96
(0.179) (7.336) (4.837) (0.065)

R^2=0.978

Where, MOTHRS is import of goods other than consumer goods, intermediate goods and oil, XPORT is the total value of export, XDEFL96 is export deflator, GNP96 is real (with respect to the base year of 1995-96) gross national product, XCHRAT is the exchange rate, and MDEFL96 is import deflator.

Identities in the Trade Block

XPORT=XCASH+XRGAR+XOTHRS
XPORT96=XPORT/XDEFL96
MPORT=MCONS+MOIL+MINTGOOD+MOTHRS
MPORT96=MPORT/MDEFL96
CAB=SAVN-INV

Where, XPORT is the total value of export, XCASH is export of cash products, XRGAR is export of readymade garments, XOTHRS is export of goods other than cash products and readymade garments, XPORT96 is export at constant price of 1995-96, XDEFL96 is export deflator, MPORT is the total value of import, MCONS is import of consumer goods, MINTGOOD is import of intermediate goods, MOIL is import of crude oil and petroleum products, MOTHRS is import of goods other than consumer goods, intermediate goods and oil, MPORT96 is import at constant price of 1995-96, MDEFL96 is import deflator, CAB is current account balance, SAVN is total savings, and INV is total investment.

2.5 Production Block

Equation 24: Supply Function of Agricultural Products

LOG(AGRVA96)=3.348+0.016*LOG(LABAGR)+0.326*LOG(ACREAGE)+
(5.53) (5.706) (5.673
0.042*DUMLAB+0.4*LOG(K96)+ 1.05E-05*MOIL/PRCWP)
(7.579) (32.77) (2.704)

R^2=0.988

Where, AGRVA96 is value added by agriculture at constant prices (with respect to the base year of 1995-96), LABAGR is labour force employed in the agricultural sector, ACREAGE is total cropped area, DUMLAB is a dummy variable for taking the value of 1 for the years of 1997 onwards to capture the changes in the definition of total labour force in the Labour Force Survey, K96 is the real capital in the economy, MOIL is the import of oil and petroleum products, and PRCWP is the world price of crude petroleum.

Equation 25: Supply Function of Industrial Products

LOG(INDVA96)= - 3.842 + 0.053*LOG(LABMFG) + 1.079*LOG(K96)
(-19.01) (17.026) (73.575)
+0.009*DUMLAB +5.68E-06*MOIL/PRCWP
(1.53) (0.803)

R^2=0.993

Where, INDVA96 is value added by industry at constant prices (with respect to the base year of 1995-96), LABMFG is labour force employed in the manufacturing sector, K96 is the real capital in the economy, DUMLAB is a dummy variable for taking the value of 1 for the years of 1997 onwards to capture the changes in the definition of total labour force in the Labour Force Survey, MOIL is the import of oil and petroleum products, and PRCWP is the world price of crude petroleum.

Equation 26: Supply Function of Services

LOG(SERVA96)=2.654 + 0.042*LOG(LABSERV)+0.7*LOG(K96)
(45.95) (30.349) (162.69)
+1.92E-06*MOIL/PRCWP
(0.818)

R^2=0.999

Where, SERVA96 is value added by service at constant prices (with respect to the base year of 1995-96), LABSERV is labour force employed in the service sector, K96 is the real capital in the economy, MOIL is the import of oil and petroleum products, and PRCWP is the world price of crude petroleum.

Identities in the Production Block

GDP96=AGRVA96+INDVA96+SERVA96
GDPCP=GDP96*GDPDEF96
GDPFC=GDPCP-INDTX
GNP=NFIABR+GDPCP
GNP96=GNP/GDPDEF96
K=INV+K(-1)*(1-DEPK)
K96=K/INVDEF96

Where, GDP96 is real (with respect to the base year of 1995-96) gross domestic product, AGRVA96 is value added by agriculture at constant prices (with respect to the base year of 1995-96), INDVA96 is value added by industry at constant prices (with respect to the base year of 1995-96), SERVA96 is value added by service at constant prices (with respect to the base year of 1995-96), GDPCP is the gross domestic product at current market price, GDPDEF96 is GDP deflator, GDPFC is GDP at factor cost, INDTEX is the total amount of indirect tax, GNP is gross national product, NFIABR is net factor income from abroad, GNP96 real (with respect to the base year of 1995-96) GNP, K total capital in the economy at current prices, INV is total investment, DEPK is the depreciation rate, K96 is the real capital in the economy, and INVDEFL96 is investment deflator.

2.6 Prices, Foreign Income and Poverty Block

Equation 27: Consumer Price Index

CPI96=-13.263+0.012*PRCWP*XCHRAT+1.056*WAP96
(-9.105) (19.52) (67.05) R^2=0.991

Where, CPI96 is consumer price index (with respect to the base year of 1995-96), PRCWP is the world price of crude petroleum, XCHRAT is exchange rate, and WAP96 is wholesale price index of agricultural products (with respect to the base year of 1995-96).

Equation 28: Poverty Equation

LOG(POVHCN)=9.711-0.421*LOG(GDPCP)
(71.08) (-41.566) R^2=0.926

Where, POVHCN is poverty rate according to the head count ratio and GDPCP is the gross domestic product at current market price.

Equation 29: Net Foreign Income from Abroad

NFIABR=-97334.847+4.91E+15*(LABTT-LABAGR-LABSERV-LABMFG)
(-12.84) (2.633)
+4039.174*XCHRAT
(21.90) R^2=0.799

Where, NFIABR is net foreign income from abroad, LABTT is total labour force in the economy, LABAGR is labour force employed in the agricultural sector, LABMFG is labour force employed in the manufacturing sector, LABSERV is labour force employed in the service sector, and XCHRAT is exchange rate.

2.7 Model Validation

The Root Mean Percent Square Error (RMPSE) were calculated for the econometric model estimated in this study. It shows that out of 29 equations estimated in this model, 15 of the endogenous variables are within 5% RMPSE range, 7 variables are within 5-10% RMPSE range, 2 variables are within 10-15% RMPSE range and the rest (5 variables) have RMPSE above 15%. RMPSEs are calculated for the period 1982-2005 within which the parameters of the model are estimated.

Table 2.1: Econometric Model Validation using RMPSE

RMPSE %	Variables (endogenous)
0 - 5%	Consumption, Investment, Demand Deposit, Time Deposit, Government Credit from Banks, M2, Exports, Imports, Agricultural output, Industrial Output, Service Sector Output, CPI, Net Factor income from Abroad [CONPRI96 INVPRI96 DEMDEP TIMDEP CRDSB M2R XCASH XOTHRS MCONS MINTGOOD AGRVA96 INDVA96 SERVA96 CPI96 NFIABR]
5 - 10%	Government Revenues, Non Tax Revenue, Annual Development Expenditure, Other Imports [REVITX REVCUS REVOTHX NTAXREV REVEXP ADPEXP MOTHRS]
10 - 15%	Export of garments, Poverty Head Count Ratio [XRGAR POVHCN]
Above 15%	Revenue earnings from VAT, Net Foreign Asset, Credit from Central Bank, Import of Oil [REVSVAT TTGDEBT NFA CRDBB MOIL]

Calibration of the model was done to pass the equations of the model through the actual data points before the impact simulation were performed in BANSIM II.

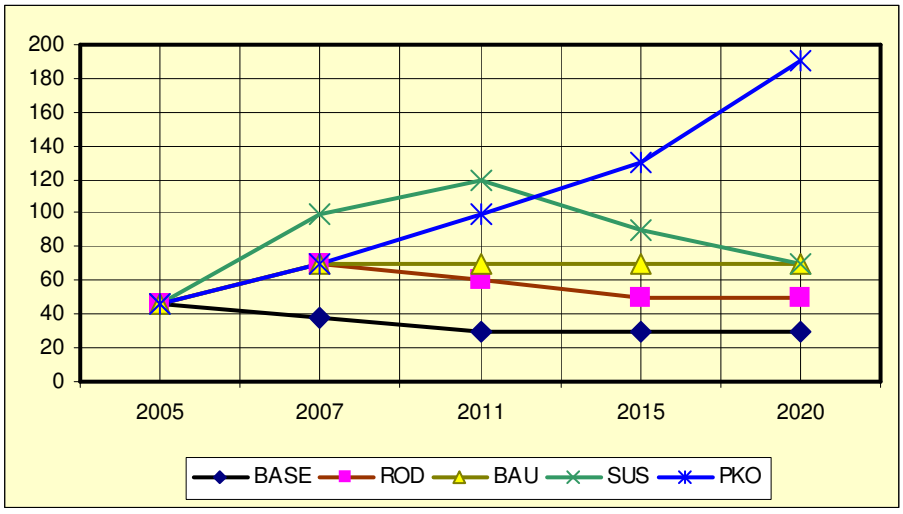
3.0 Impact of World Oil Price Change

BANSIM II is used to understand the impact of price rises (world prices) on the economy of Bangladesh in terms of a) macro economic indicators - like consumption, investment, government expenditure, and export and imports, b) inflation, c) poverty and d) government's budget deficit.

3.1 World Oil Price Scenarios

A total of five different world oil price scenarios have been used to simulate impact of world oil price changes. The **base scenario (BASE)** is set to understand 'what if' the world oil price remains where it was in 2002 prior to price rise. This can be compared with **reduced oil demand (ROD)** scenario in which price of oil was set to rise until it triggers a change in the demand for oil and people switch to substitute sources of energy (such as gas in Bangladesh). Next is the **Business As Usual (BAU)** scenario under which price of oil is set to the level of 2006 at 70$ per barrel and stays like that until 2020. Next is the **supply shock (SUS)** scenario under which it is assumed that rising oil price will lead to higher investment in the oil sector and consequently a gradual supply increase will take place from 2011 and onward leading to decrease in world oil prices. Finally the **Peak Oil demand (PKO)** scenario assumed that the trend in world oil price is going to sustain because world demand for oil is increasing rapidly and so world oil price will gradually rise

Figure 3.1: World Oil Price scenarios used in simulation exercise



up to 190$ per barrel in 2020. However, it is also assumed that with increased oil prices, countries might find a substitute and reduce their oil demand. In terms of the broad picture, base scenario assumed an average price of $33 per barrel of oil, under the ROD scenario price will be $55 per barrel, it is $65 per barrel under BAU scenario and it is $85 and $107 per barrel under SUS and PKO scenarios. The price scenarios used in this simulation are shown in Figure 3.1 above.

3.2 Impact on inflation

Oil is an input in the process of production. Consequently, it is expect that increase in the oil price will increase the cost of production and hence will lead to a supply shift in the aggregate economy leading to cost-push inflation.

Table 3.1: Inflation rate due to world price changes

	BASE	ROD	BAU	SUS	PKO
			per cent		
2005	6.48	6.48	6.48	6.48	6.48
2007	-2.69	8.47	8.47	8.47	8.47
2011	-3.08	6.29	6.29	20.80	6.29
2015	1.26	0.60	1.78	4.15	5.34
2020	1.27	0.56	1.81	4.22	5.40
Average	**0.65**	**4.48**	**4.97**	**8.82**	**6.40**

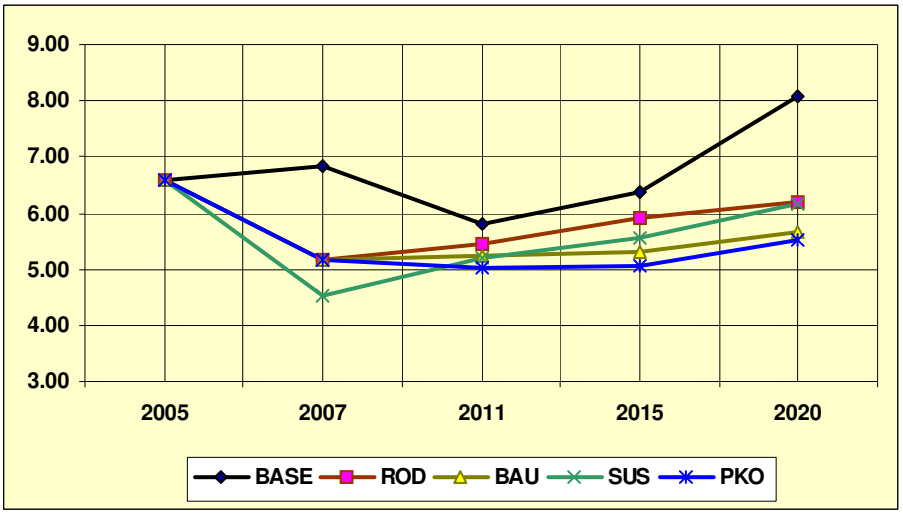
Source: BANSIM II, 2007

Table 3.1 shows that impact on inflation is also intuitively clear. Average rate of inflation under BASE scenario is very low (given *ceteris paribus)*, while it grows to 4.48 percent due to increased oil prices under ROD scenario, it grows further to 4.97 percent under BAU scenario. However, if oil prices continue to rise (as is under SUS until 2011) the rate of inflation increases to nearly 20.80 percent in 2011. Under PKO scenario, inflation increases to 6.4 percent from the base scenario of 0.65 percent. In terms of year to year comparison, in Bangladesh, SUS will have a significantly negative impact on inflation until 2011. Under other scenarios inflation will rise up to 8.47 percent in the short run (until 2007) and then it will start falling (given *ceteris paribus).*

3.3 Impact on GDP

Rise in world oil process is expected to have impacts on GDP and its growth rate. Figure 3.2 shows the impact of world oil price increase on GDP of Bangladesh. In

Figure 3.2: Impact on GDP growth rate



terms of GDP growth rate the Figure 3.2 shows that the base line scenario provides the highest growth rates for Bangladesh.

Table 3.2: Changes in GDP growth rate due to world oil price rise

	BASE	ROD	BAU	SUS	PKO
2005	6.60	6.60	6.60	6.60	6.60
2007	6.82	5.17	5.17	4.54	5.17
2011	5.81	5.45	5.25	5.19	5.04
2015	6.38	5.91	5.29	5.56	5.06
2020	8.07	6.20	5.67	6.17	5.51
Average	**6.74**	**5.87**	**5.60**	**5.61**	**5.47**

NOTE: GDP growth rates in percentage terms. Results from BANSIM II simulation.

Table 3.2 further clarifies the numbers. It shows that from the current growth rate of 6.6 percent in 2005 and it would have gradually increased to 8.07 percent with the baseline scenario. Under reduced oil demand (ROD) scenario growth rate falls to 5.17 in 2007 and it will be at 6.2 percent in 2020. If, however, the current oil prices (at $70 per barrel under BAU scenario) remain as it is the growth rate will fall further to 5.67 percent by 2020. The supply shock scenario (SUS) under with

alternative fuel can be found, growth rate falls until 2007 and then it picks up up to 6.17 by 2020 and under PKO scenario (peak oil demand) growth rate falls to 5.47 percent, the lowest.

Table 3.3: GDP of Bangladesh under different world oil price scenarios

	BASE	ROD	BAU	SUS	PKO
			in million taka		
2005	2935395	2935395	2935395	2935395	2935395
2007	3334721	3241964	3241964	3222585	3241964
2011	4171037	4010350	3988886	3957802	3955012
2015	5291286	5003048	4896415	4896416	4814147
2020	7508588	6656256	6394751	6480621	6209113
Average	**4648205**	**4369402**	**4291482**	**4298564**	**4231126**
% change		**-5.99**	**-7.67**	**-7.52**	**-8.97**

In terms of GDP of Bangladesh, Table 3.2 shows that between baseline scenarios GDP of Bangladesh falls by 5.99 to 8.97 percent due to oil price increases.

3.4 Impact on Poverty

Oil price increase leads to domestic price increase through a) increase in prices of importable, and b) increase in the cost of fuel within the economy and thereby affecting the domestic prices. This will affect the poor people. Consequently, the process of poverty reduction will be affected.

Figure 3.3: Increase in Poverty (difference between BASE and other scenarios

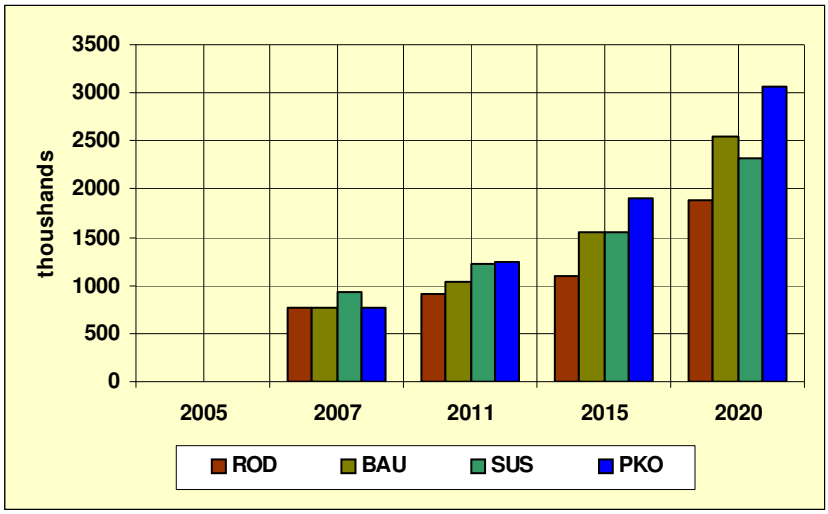


Table 3.4: Population living in extreme poverty under different price scenarios

	BASE	ROD	BAU	SUS	PKO
2005	31027.13	31027.13	31027.13	31027.13	31027.13
2007	28220.97	28987.81	28987.81	29153.44	28987.81
2011	24052.46	24967.50	25095.14	25282.43	25299.36
2015	20226.41	21332.35	21773.64	21773.62	22127.09
2020	15493.60	17373.34	18047.90	17820.54	18560.33

Source: BANSIM II simulation results. (numbers are in thousands)

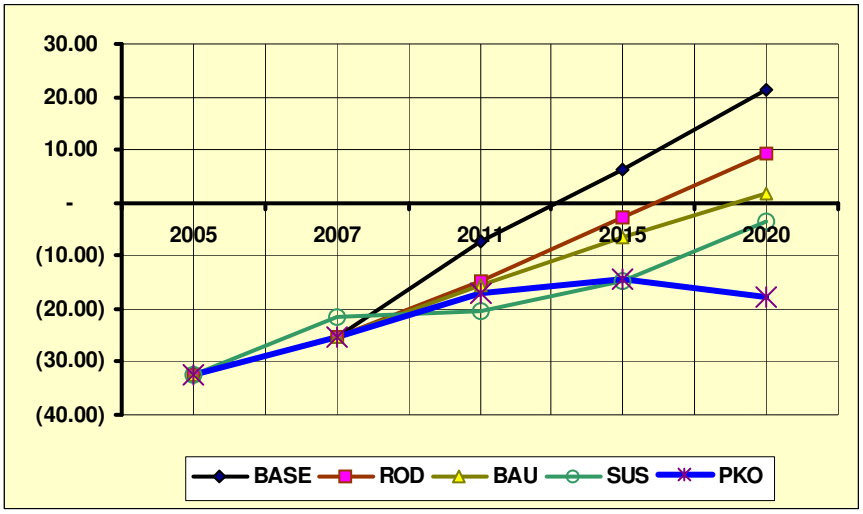
Table 3.4 presents the number of individuals (in thousands) under different world price scenarios. It shows that compared with the base price scenario, under reduced oil demand scenario, 1.8 million people will slip into poverty by 2020. This means that compared with the prices of oil as of 2002 (the base scenario), under reduced oil demand, addition 1.8 million population cannot leave the poverty cycle in Bangladesh. However, if the oil prices remains as it is (current level of 70$ per barrel), an additional 2.5 million people will fail remain trapped into poverty. This number will rise to 3 million under the peak oil demand price scenario when oil price (Figure 3.3).

Since 1990 Bangladesh has succeeded in reducing its poverty by 1% annually and this is required for achieving its MDG goal. All these gains will be halted in future due to rising prices of oil. Considering this, world oil price increase will have a significant effect on the success of MDGs for Bangladesh.

3.5 Impact on Government Budget

Like many other governments in the developing countries and in least developed countries, Bangladesh government has been maintaining an administered price of oil to ensure a) cheap transportation costs, b) lower irrigation expenditure, and c) to maintain a low rate of domestic inflation. While these are the priorities of the elected governments who cannot afford to increase fuel prices due to fear of political turmoil, the impact on the government exchequer has been quite devastating. The government of Bangladesh, for example, in its annual budget of 2005-2006 has asserted that despite the readjustment of administered prices (several times in 2003 onwards) there has been an accumulation of huge public debt due to this. Outstanding loan of Bangladesh Petroleum Corporation (BPC) in 2005-06 is about 9000 crores taka or 428 million dollars. Comparing this with total subsidy on

Figure 3.4: Percent of Budget Deficit



public enterprises of 73 million dollars it is clear that there is a huge fiscal implication of keeping low administered prices in Bangladesh when world oil price increases. The current budget deficit of the government is around 32 percent of its revenue. The current trend is that government is reducing the gap. Simulation result suggests that under the BASE price scenario, the government of Bangladesh would have been able to get out of deficit budget by 2012 (Figure 3.4). However, under the reduced oil demand (ROD), the budget deficit could turn into a surplus by 2016/17. However, the budget deficit will worsen under the PKO price scenario.

Overall, our model shows that while under the BASE price scenario, the average budget deficit (for 2005-2020) is 7.46 percent, it will rise to 13.21 percent under ROD price scenario, 15.64 percent under BAU price scenario, 18.52 percent under SUS price scenario and 21.39 percent under PKO price scenario.

4.0 Concluding Observations

BANSIM II model has been used in this exercise to understand the impact of world oil price changes on the economy of Bangladesh. Following concluding observations can be drawn from this model;

- The impact of rising world oil prices on the economy of Bangladesh and on the poverty is substantial.

- Five scenarios were developed to understand the impact. In the baseline scenario world oil prices are set to remain stable at its 2003 level of around US$ 30 per barrel throughout the period (2005-2020). In the reduced oil demand (ROD) scenario world oil prices are set to rise to the current level of US$70 (in 2005) and then falls back to $50 per barrel. In the business as usual (BAU) scenario world oil prices were increased to US$70 in 2007 and remained stable at $70 during the entire period. In the supply shock (SUS) scenario, world prices of oil has increased to 120 by 2011 and then reduces to 70 US$ per barrel by 2020 and in the peak oil demand (PKO) scenario world oil prices gradually increases to 190 US$ per barrel by 2020.

- Compared with the baseline scenario, reduced oil demand scenario reduces GDP of Bangladesh by an average of 5.99% while business as usual scenario reduces it by 7.69%, the supply shock scenario reduces GDP by nearly 7.52% and in case of peak oil demand scenario GDP loss is about 8.97%. These results are for the entire simulation period (2005-2020). During the forecast period the model assumed: agricultural acreage remained constant, growth of vehicles remain fixed at the current rate, all deflators maintain a constant growth rate (of 2005), foreign aid remains constant at the level of 2005 and population increases at the current rate of 1.33%. Consequently, the simulation results would vary if forecasts on these variables are available for 2005-2020 period.

- In terms of inflation, while the current inflation rate in the model for 2005 is 6.48%, during the entire simulation period, average rate of inflation for the baseline scenario is around 0.65 percent (2005-2020), while under ROD scenario it increases to 4.48%, for BAU it is 4.97%, for SUS it is 8.82 and for PKO it is 6.42%. The model predicts an inflation rate of 8.47 percent in 2007 and the current inflation rate is 8.29 percent. Model also shows that a sharper rise in world oil prices will lead to more inflationary pressure than a slower increase in prices.

- In terms of hardcore poverty (head count ratio), the 2005 poverty rate in Bangladesh is 22.64%. Under the baseline line scenario it would have dropped to 9.27% by 2020. However, under ROD scenario the percent of hardcore poor will be 10.4% in 2020. This means that nearly 1.89 million people slipped through the net due to oil price increases. Under the BAU

scenario (with world oil prices at 70$ per barrel), the percent of poor people will be 10.80 meaning about 2.55 million people slipped through the poverty reduction strategies of the government due to oil price increase. Under the supply shock scenario, the number of hardcore poor population will be 2.3 million (a slight improvement when alternative fuel is used to combat oil price increase) and under peak oil demand scenario nearly 3.1 million people will slip through the poverty reduction strategy of the government of Bangladesh due to oil price increase. All these numbers are compared to the baseline scenario.

- Consequently, poverty reduction program of the Bangladesh government will be seriously affected due to oil price increase.
- In terms of fiscal deficit, oil price increase will trigger in several fiscal problems for the government of Bangladesh. First, reduction on income and output will result in budgetary deficits and second government will be faced with budget deficit due to differences in prices between the domestic market and the world market.
- BANSIM II takes in to account of the fiscal problem arising out of fall in income and output. The simulation results suggest that for the entire period of simulation the budget deficit would have been 7.6 percent (of government revenue earnings) if the prices are following the baseline scenario. The deficit will increase to 13 percent if the world prices follow the reduced oil demand forecasts. Deficit will further rise to 15.6 percent under BAU scenario. It will further rise to 18 percent under supply shock oil price scenario and will be around 21 percent under peak oil demand oil price scenario. In reality, however, government will have to make a rather difficult choice and allow increase world oil prices pass through the system and will farther affect the domestic prices.

Finally, from the above observations it should be clear that simulation model has also underestimated the impact of oil price increases on the economy and poverty of Bangladesh. For example, first, if the government of Bangladesh allows the pass through of world prices in to the domestic economy, affect on inflation will be much higher than that was predicted in this model. Since such pass through was not observed for many years the econometric model was unable to estimate the affect. Second, a few of the exogenous variables in the

model includes deflators, interest rates and exchange rates. The model used a heuristic assumption to simulate into the future. Since the original model did not include prices, this model did not make all the prices endogenous. However, if these prices were made endogenous, the effect of oil prices would be much higher.

However, despite these limitations, the model has been able to show that world oil price increase will seriously derail the MDG targets in countries like Bangladesh. To combat such situation and to ensure that MDG targets are achievable the world community must design programs to help the poor people who will miss the bus and cannot get out of poverty for reasons beyond their control.

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