A Small Macroeconometric Model of Pakistan's Economy

Introduction

- Over the past three decades, there has been growing interest in developing macro-econometric models based on the theoretical foundations to examine the inter-linkages between various sectors of the economy.

- MEM is useful tool in assessing the economic performance and effectiveness of various economic policies.

- It facilitate governments and policymakers to carry out in-depth policy analysis and forecast the future directions and trends of the economy.

- For the forecast of key macroeconomic variables many central banks of the world are still using macroeconometric models.
- The concept of macroeconometric modeling can be traced back to Klein (1950), Klien and Goldberger (1955). They have constructed large macro models for the US economy. Fair developed large macro model for US economy in 1976 and multicountry model in 1984.
- However, due to the partial failure of forecast and theoretical shortcoming of the large macro-models led to shift the emphasizes to the small size MEMs.

- In the context of Pakistan two MEMs are available with different objectives. These models include:
  - **PIDE-MEM developed by Naqvi et al. (1983, 1993)**

    [consisting of **97** equations of which **45** are behavioural and **52** definitional equations]
  - **SPDC MEM due to Pasha et al. (1995)**

    [consists of **321** equations of which **159** are behavioural]
- Some sub-sector MEMs due to Haque et al. (1994) and Chishti et al. (1998) are available.
  - However, these models do not cover all sectors of the economy.

Structural Changes of 90s

- The economy of Pakistan has undergone various structural changes since 1990. These includes:

  - financial and trade liberalization,
  - exchange and payments liberalization,
  - changes in agricultural, industrial and investment policies.

- These changes are expected to effects different sectors of the economy and have changed the structural relationship between various macroeconomic variables.

Objective

- The main purpose of this study is to examine the impact of policy changes on the economy by constructing a small-size dynamic MEM of Pakistan's economy.

Main Features of the Model

The present model covers five key blocks of the economy:

- – Production Block
- – Aggregate Expenditure Block
- – Fiscal Block
- – Monetary Block, and
- – External Block.

1: Production Block

1- Production Block

Production activities have been disaggregated into three major sub-sectors:

(1) agriculture sector,

(2) Industrial sector, and

(3) services sector.

Agriculture Sector

- This sector includes (a) major and minor crops, (b) livestock, (c) fishing and (d) forestry. The agriculture sector can be modeled as:

$$YA = F (LA, DCa, TW, RDL, U) \qquad (1)$$

Where

YA = Agricultural sector value added

LA = Labour Force engaged in Agri: Sector

DCa = Credit disbursement to Agri: Sector

TW= No. of tube wells

RDL= Road length used as proxy for
     Infrastructure

U = error term

All the variables are expected to influence agriculture sector's value added positively.

Manufacturing Sector

This sector includes; (a) mining and quarrying, (b) large and small scale manufacturing, (c) construction, (d) electricity, and (e) gas.

$$Ym = F(Lm, DCm, RIR, MM, RDL, YA, U) \quad (2)$$

Where

Ym = Value added in manufacturing sector

Lm = Labour force engaged in manufacturing sector

DCm = Credit disbursement to manufacturing sector

RIR = real interest rate (lending rate)

MM = Import of machinery

RDL = road length and YA is agri: value added

Services Sector

This sector includes; (a) transport & communication, (b) wholesale and retail trade, (c) finance and insurance, and (d) public administration etc.

$$YS = F(AD, U) \qquad (3)$$

Where

YS = value added of Services sector

AD = aggregate demand

$$GDP = YA+YI+YS \qquad (4)$$

2: Aggregate Demand Block

Aggregate Demand

The aggregate demand can be decomposed into aggregate consumption and aggregate investment sub-sectors

(1) Consumption: The aggregate consumption sub-sector has been disaggregated in to:

- private consumption, and
- government consumption

(a) Private Consumption

Real private consumption (PC) can be expressed as a function of real disposable income (RYd) and real interest rate (RIR)

$$PC = F(RYd, RIR, U) \tag{5}$$

Where

$$RYd = (GDP- TXR + WR- CRP)/CPI \tag{6}$$

TXR= Tax revenue
WR = Worker's remittances
CRP= Credit to private sector, and
CPI = Consumer price index

(b) Government Consumption

The government consumption (GC) can be modeled as:

$$GC = F \, (EXDEV/GDP, \, GR, \, INF, \, U) \qquad (7)$$

Where

EXDEV/GDP = ratio of dev: expenditures to GDP

GR = government revenues

INF = inflation rate

(2) <u>Investment</u>

Real gross investment has been disaggregated into private sector investment and government investment.

<u>Private investment (PI)</u>

- PI play a key role in sustaining the development process by promoting economic growth. PI decisions depend on the investment in long-lived capital assets and expectations about the future.

- PI depends on the level of real income (RY), real interest rate (RIR) and private sector credit (CRP) and government investment (GI). Therefore:

$$\textbf{PI = F (RY, RIR, CRP, GI, U)} \qquad \textbf{(8)}$$

Government investment (GI)

GI is measured by the expenditures on capital construction and innovations, serves as fiscal policy instruments (used in reducing unemployment and reducing GDP gap).

In this model GI is taken as an exogenous variable.

$$GI = GI_0 \tag{9}$$

$$G = GC + GI$$

3: Fiscal Block

Fiscal Block

Fiscal block constitutes government revenue (GR) and government expenditures (GEX). In this sector budget deficit (BD) is results when GEX > GR. Budget deficit is defined as:

$$\textbf{BD = (GEX-GR)} \tag{10}$$

GR is the sum of direct tax revenue, indirect tax revenue and non-tax revenue. That is

$$\textbf{GR=(DTXR+INDTXR+NTXR)} \tag{11}$$

DTXR=direct tax revenue

INDTXR= indirect tax revenue

NTXR= non-tax revenue

(i) **Direct Tax Revenue**

Direct taxes may be influenced by nominal output (NGDP), average direct tax rate (ATR) and inflation rate (INF). Therefore:

$$\text{DTXR} = F(\text{NGDP, ATR, INF, U}) \qquad (12)$$

(ii) **Indirect Tax Revenue**

Indirect tax may be influenced by nominal output, average indirect tax rate and inflation rate. Therefore:

$$\text{INDTXR(j)} = F(\text{NGDP, ATR, INF, U}) \qquad (13)$$

INDTXR = Sales tax + Custom duties etc

Government Expenditures

Government expenditures (GEX) consists of Current Expenditures (EXCUR), DEV: expenditures (EXDEV) and expenditure on capital disbursement (EXCD). Therefore;

$$\textbf{GEX = EXCUR + EXDEV + EXCD} \qquad (14)$$

and EXDEV and EXCD are taken as exogenous variable in this model.

$$EXDEV = EXDEV_0$$
$$EXCD = EXCD_0 \qquad\qquad (15)$$

4: Monetary Block

Monetary Block

Demand for Real Balances

The demand for real money balances

can be modeled as:

(M/P)d = F (RGDP, R, INF, U)   (17)

Where

   (M/p)d   = Real Money Balances (M2 definition)

   RGDP   = Real GDP

   R   = Nominal Interest Rate

   INF   = Inflation Rate

Interest Rate Equation

To capture the monetary policy change we have modeled the interest rate function as:

$$R = F(MS, P, Dis: Rate, U) \tag{18}$$

Where MS = Money Supply (M2 definition)

P = General Price level

Dis: Rate is policy discount Rate

Price Equation:

The final equation will be:

$$P = F(MS, RGDP, R, PF, RER, U) \tag{19}$$

5: External Block

External Block

The foreign sector consists of equations for the exports of goods and services and imports of goods and services.

Exports Demand Function

$$REX = F (YF, REER, RPX, U) \qquad (22)$$

where REX = real value of exports of goods and
                services

       YF = World Income

       REER = Real effective exchange rate

       RPX = Relative price of exports to CPI

Imports Function:

**RIMP = F (REER, RGDP, WREM, RPM, CRP,
U)**   (23)

Where

REER   =   Real Effective Exchange Rate

RGDP   = Real GDP

WREM   = Worker's Remittances

RPM   = Relative Price of Imports

CRP   = Credit to private sector

Summary

PRODUCTION

$$YA = F (LA, DCa, TW, RDL, U) \qquad (1)$$

$$Ym = F(Lm, DCm, RIR, MM, RDL, Ya, U) \qquad (2)$$

$$YS = F(RAD, U) \qquad (3)$$

CONSUMPTION AND INVESTMENT

Consumption

$$PC = F(RYd, RDR, U) \qquad (5)$$

$$GC = F (EXDEV/GDP, GR, INF, U) \qquad (7$$

Investment

$$PI = F (RY, RIR, CRP, GI, RVM, U) \qquad (8)$$

$$GI = GI_0$$

Expenditures & Revenues

$$DTXR = F(\ GDP, ATR, INF, U) \tag{11}$$

$$INDTXR(j) = F(\ GDP, ATR, INF, U) \tag{12}$$

$$GEX = EXCUR + EXDEV + IPFD \tag{15}$$

Money, Interest Rate and Prices

$$(M2/P)d = F(GDP, R, INF, U) \tag{16}$$

$$R = F(Ms, P, Dis:Rate, U) \tag{17}$$

$$P = F(MS, RGDP, R, PF, RER, U) \tag{18}$$

Exports of G& S

$$REX = F(RGDP, REER, RPX, YF, U) \tag{19}$$

Imports of G & S

$$RIMP = F(REER, RGDP, WREM, RPM, CRP, U) \tag{20}$$

Identities

$$RYd = (GDP - TXR + WR - CRP)/CPI \qquad (6)$$

$$INV = PI + GI \qquad (7)$$

$$CONS = PC + GC \qquad (8)$$

$$BD = (GEX - GR) \qquad (9)$$

$$TGR = (DTXR + INDTXR + NTXR) \qquad (10)$$

$$GEX = EXCUR + EXDEV + EXCD \qquad (15)$$

$$TB = REX - RIM \qquad (16)$$

$$GDP = CONS + INV + TB + \text{Change in Stocks} \qquad (17)$$

Blocks	Behavioural EQS
Production	3
Consumption & Investment	3
Govt. Expenditures & Revenues	2
Money, interest rate and Prices	3
International Trade	2
Total	13
Identities	8

Working of the model

The model consists of 21 equations of which 13
are behavioural equations and 8 are identities
and linking equations.

- – Production affects consumption, imports, exports,
  government revenues and government expenditures,
  which in turn affects the domestic price level.

- – Private sector credit affects private investment which
  affect the level of output through the change in capital
  stock.

- Public investment influences private investment which affect the economy through various channels.

- Foreign price affect general price level, which in turn affect the prices of raw material.

- General prices are also affected by real and monetary variables.

- real effective exchange rate determines the volume of imports, which in turn affects private investment.

- private investment affects real output, which affects government revenue and expenditures and hence budget deficits.

– Furthermore, disequilibrium between aggregate demand and aggregate supply also affects domestic price level.

– Therefore, market clearing may be achieved through monetary and fiscal policies adjustment.

Methodology

- We have estimated the model using annual data over the period 1972-2009.

- Because of relatively small sample size and outliers in the data, we employ single equation Error-Correction methodology to estimate all the behavioural equations.

Empirical Results

- Before moving to cointegration analysis we have examined the time series properties of the data using ADF unit root test.

- We find that;
  - all the series under consideration follow I (1) processes.

- To assess the appropriateness of the estimated equations, a battery of diagnostic tests such as:
  - Jarque-Bera (JB) for normality of residuals, Lagrange Multiplier (LM) for series correlation, autoregressive conditional heteroscedasticity (ARCH), Remsay's RESET for functional specification are applied.
  - Stability of each equation(s) are checked by employing CUSUM and CUSUMSQ

Results

Production Block

Agriculture Sector

Long Run Results

$$Ln(Ya) = 3.62 + 0.28\ Ln(La) + 0.31\ Ln(RDL) + 0.40\ Ln(TW) -0.04\ Ln(DCa) + 0.03D90$$
$$\quad\quad (9.06)\ (1.82) \quad\quad (4.99) \quad\quad\quad (7.83) \quad\quad (-2.44) \quad\quad\quad (1.20)$$

RSS = 0.04   Sigma = 0.04   R^2 = 0.99   Radj^2 = 0.99   ADF = -4.76*

Normality test = 1.96 [0.376]   LM test   = 3.85 [0.427]

ARCH test   = 0.02 [0.885]   Hetero test   = 5.02 [0.832]

RESET   = 5.31 [0.029]

Short-Run Dynamics

$$D(lnYa) = 0.31D(LnYa(-1)) + 0.21D(LnLa(-1)) + 0.04D(LnDCa(-1)) + 0.28D(lnRDL)$$
$$\quad\quad (2.31) \quad\quad\quad (1.70) \quad\quad\quad (2.13) \quad\quad\quad (1.90)$$
$$\quad - 0.92\ ECa(-1)$$
$$\quad (-5.54)$$

$$(28)$$

RSS = 0.03   Sigma = 0.02   R^2 = 0.46   Radj^2 = 0.38

Normality test = 1.07 [0.586]   LM test   = 0.01 [0. 913]

ARCH test   = 0.02 [0.863]   Hetero test   = 18.07 [0.054]

RESET   = 0.04 [0.841]

Manufacturing Sector

Long Run Results

$Ln(Ym) = 0.34\ Ln(Lm) + 0.55\ Ln(RDL) + 0.17\ Ln(MM) - 0.12Ln(DCm)$

      (1.80)   (3.05)   (4.23)   (-3.03)

       $+0.31Ln(Ya)$

       (1.93)   (29)

  RSS = 0.12 Sigma = 0.06 R^2 = 0.99 $Radj^2$ = 0.99 ADF = -3.35**

    Normality test = 3.06 [0.216]   LM test   = 14.40 [0.006]

    ARCH test   = 3.69 [0.055]   Hetero test = 16.45 [0.088]

    RESET   = 1.29 [0.256]

Short-Run Dynamics

$D(LnYm) = 0.66D(LnYm(-1)) + 0.49D(LnRDL) - 0.10D(LnDCm) + 0.26D(lnYa)$

      (6.02)   2.88)   (-1.43)   (1.96)

      -0.32 ECm(-1) -0.009D97   (30)

      (-3.56)   (-0.58)

RSS = 0.03   Sigma = 0.03 R^2 = 0.36 $Radj^2$ = 0.24

Normality test   = 2.43[0.297]   LM test   = 1.33[0. 249]

ARCH   = 0.72[0.394]   Hetero test = 3.48[0.983]

RESET   = 0.71[0.400]

Services Sector

Long Run Estimates
Ln(Ys) = 4.00 + 0.98 Ln(RAD) + 0.13 D90   (37)
        (28.61)   (67.49)   (6.57)
RSS = 0.09   Sigma = 0.05   R^2 = 0.99   Radj^2 = 0.99   ADF = -2.64
Normality test   =   0.067 [0.967]   LM test   = 17.86 [0.001]
ARCH test   =   14.35 [0.001]   Hetero test   = 5.30 [0.151]

Short-Run (VAR) Estimates
D(LnYs) = 0.04 +0.22 D(LnYs(-1)) +0.20D(LnRAD) - 0.02 D97   (39)
            (3.61) (1.51)   (2.65)   (-2.38)

RSS = 0.009   Sigma = 0.02   R^2 = 0.37   Radj^2 = 0.31
Normality test =   2.77[0.250]   LM test   = 8.01[0.091]
Hetero test   =   10.66 [0.058]   ARCH test   = 5.32[0.021]
RESET test   =   2.37E-05 [0.996]

Aggregate demand block

Private consumption

Long-run Estimates

$LnPC = 5.30 + 0.93 \, LnYd - 0.01 \, RDR*D00$ (33)

      (23.86) (41.40)   (-2.53)

RSS = 0.05   Sigma = 0.04 R^2 = 0.99   R^2 adj = 0.99

Normality test = 2.40 [0.301]   LM test = 10.99 [0.037]

hetero test = 3.19 [0.527]   ARCH test = 0.59[0.441]

RESET = 1.70 [0.192]   ADF = -3.23**

Short-run Estimates

$D(lnPC) = 0.03 + 0.36 \, D(LnYd(-1)) - 0.61 ECPCON(-1)$ (34)

      (2.72) 2.04)   (-4.15)

RSS = 0.03 Sigma = 0.03 R^2 = 0.42 R^2 adj = 0.37

Normality test = 0.727[0.695]   LM test = 4.96[0.291]

hetero test = 2.45 [0.654]   ARCH test = 1.96 [0.161]

RESET = 0.20[0.658]

Government Consumption

Long-Run Estimates

LnGC = 9.00 + 0.15Ln(EXDEV/GDP)+0.29 Ln(GR)   (41)

     (16.79) (3.31)   (8.99)

RSS = 0.47   Sigma = 0.13   R^2 = 0.91   R^2 adj = 0.91

Normality test =   0.61 [0.736]   LM test   = 15.15[0.004]

hetero test   = 7.31[0.120]   ARCH test = 2.53[0.112]

RESET   = 5.95 [0.015]   ADF   = -2.66

T = 1979-2008

Short-Run (VAR) Estimates

D(LnGC) = -0.45D(lnGC(-1))+0.11D(Ln(EXDEV/GDP))+0.42 D(LnGR(-1))

       (-2.43)   (1.79)   (2.89)

      +0.10D05   (42)

       (1.72)

RSS = 0.24   Sigma = 0.10   R^2 = 0.39   R^2 adj = 0.31

Normality test =   1.29[0.525]   LM test   = 0.93 [0.921]

Hetero test   = 10.99[0.139]   ARCH test   = 0.03 [0.862]

RESET   = 4.58[0.032]

Private Investment

Long-Run Estimates

$$LnPI = 0.72LnRY - 0.006RIR + 0.10Ln(CRP/GDP) + 0.18LnGI \qquad (38)$$
$$\quad (12.10) \qquad (-1.90) \qquad (4.72) \qquad\qquad (2.37)$$

RSS = 0.24   Sigma = 0.09   R^2 = 0.98   R^2 adj = 0.97

Normality test =   0.53 [0.767]   LM test   = 7.23[0.124]

hetero test   =   17.83 [0.023]   ARCH test = 0.02[0.889]

RESET   =   0.54 [0.464]   ADF   = -4.78*

Short-Run Dynamics

$$D(LnPI) = 0.79D(LnRY(-2)) + 0.008D(LnCRP(-1)/GDP(-1)) + 0.04D(FDI)$$
$$\quad (2.34) \qquad\qquad (0.06) \qquad\qquad\qquad (2.05)$$
$$+0.17D(LnGI(-1)) - 0.50EPI(-1) \qquad\qquad\qquad (39)$$
$$\quad (2.20) \qquad\qquad (-3.92)$$

RSS = 0.08   Sigma = 0.05   R^2 = 0.60   R^2 adj = 0.54

Normality test =   0.03[0.984]   LM test   = 1.94[0.747]

hetero test   =   16.05 [0.098]   ARCH test = 0.14 [0.704]

RESET   =   0.05 [0.820]

Monetary Block

Money Demand Function

Long-Run Estimates

LnRMd = -9.64 + 1.28LnRGDP -0.02R + 0.12D05   (45)

      (-26.32) (52.35)   (-2.85)   (3.11)

RSS = 0.13   Sigma = 0.06   R^2 = 0.99   R^2 adj = 0.99

Normality test = 1.00 [0.605]   LM test = 15.14[0.004]

hetero test   = 7.45 [0.189]   ARCH test = 1.50 [0.220]

RESET   = 2.14 [0.144]   ADF   = -3.47**

Short-Run Dynamics

D(LnRMd) = 0.37D(LnRMd(-1))+0.89D(LnRGDP)-0.02D(R)-0.53ECRMd(-1)

         (2.52)   (3.85)   (-3.15)   (-3.52)   (46)

RSS = 0.06   Sigma = 0.04   R^2 = 0.47   R^2 adj = 0.41

Normality test = 1.53 [0.465]   LM test = 2.28[0.685]

hetero test   = 9.70 [0.287]   ARCH test = 0.51 [0.474]

RESET   = 2.50 [0.114]

Interest Rate Equation

Long-Run Estimates

$R = 15.35 - 1.45Ln(MS) + 0.55 DISR - 2.85D90$ (47)

  (4.30) (-3.57)   (5.48)   (-2.30)

 RSS = 86.15   Sigma = 1.64   R^2 = 0.53   R^2 adj = 0.48

Normality test = 0.09 [0.958]   LM test = 11.56[0.021]

hetero test = 6.87 [0.230]   ARCH test = 8.97E-07 [0.999]

RESET = 0.27 [0.602]   ADF = -5.30*

Short-Run Estimates

$D(R) = -3.75 D(Ln(MS)) + 0.32D(DISR) + 0.25D(DISR(-1))$

      (-1.75)   (2.48)   (2.35)

       $-0.44ECR(-1) + 2.42D0607$ (48)

      (-3.10)   (3.18)

RSS = 31.19   Sigma = 1.04   R^2 = 0.67   R^2 adj = 0.62

Normality test = 1.99 [0.370]   LM test = 5.64[0.227]

hetero test = 10.68 [0.298]   ARCH test = 0.33 [0.566]

RESET = 1.24 [0.266]

Price Equation

Long-Run Estimates

$$LnP = 0.43LnM2 - 0.18LnRGDP + 0.01R + 0.28LnPF - 0.10D03 \qquad (46)$$
$$\quad (9.72) \qquad (-6.53) \qquad (3.76) \qquad (5.46) \quad (-4.03)$$

RSS $= 0.04$ Sigma $= 0.04$ R^2 $= 0.99$ R^2 adj $= 0.99$

Normality test $= 0.86 [0.450]$		LM test $= 15.55[0.004]$
hetero test $= 20.87 [0.013]$		ARCH test $= 8.72 [0.003]$
RESET $= 2.16 [0.142]$		ADF $= -4.47**$

Short-Run Dynamics

$$D(LnP) = 0.27D(LnP(-2)) - 0.31D(LnRGDP(-1)) + 0.27D(LnM2(-1)) + 0.003D(R)$$
$$\qquad (4.65) \qquad\qquad (-2.15) \qquad\qquad\qquad (4.60) \qquad\qquad\qquad (2.06)$$
$$+0.18D(LnPM) + 0.14D(LnPM(-1)) - 0.35ECP(-1) + 0.02D90 \quad (47)$$
$$\qquad (5.46) \qquad\qquad (4.43) \qquad\qquad (-3.88) \qquad (1.77)$$

RSS $= 0.006$ Sigma $= 0.01$ R^2 $= 0.88$ R^2 adj $= 0.85$

Normality test $= 0.65 [0.721]$		LM test $= 1.17[0.883]$
hetero test $= 17.84 [0.271]$		ARCH test $= 0.98 [0.323]$
RESET $= 1.68 [0.195]$		

Fiscal Block

Direct Tax Revenue

Long-Run Estimates

Ln(DTXR) = -7.11 + 1.24Ln(NGDP)-0.10D04   (48)

        (-16.19) (39.81)   (-0.74)

RSS = 0.85   Sigma = 0.18   R^2 = 0.98   R^2 adj = 0.98

Normality test =   0.78 [0.676]   LM test   = 23.19[0.000]

hetero test   = 8.13 [0.043]   ARCH test = 14.58 [0.000]

RESET   = 4.76 [0.029]   ADF   = -3.09***

T = 1979-2009

Short-Run Estimates

D(LnDTXR) = 0.45D(LnDTXR(-1))+0.64D(LnNGDP)) -0.26ECDTXR(-1)

       (3.47)   (3.27)   (-3.01)   (49)

RSS = 0.14   Sigma = 0.07   R^2 = 0.56   R^2 adj = 0.53

Normality test =   1.16 [0.561]   LM test   = 7.32[0.120]

hetero test   = 5.64 [0.464]   ARCH test = 0.90 [0.344]

RESET   = 1.47 [0.225]   T = 1981-2009

Indirect Tax Revenue

<u>Long-Run Estimates</u>

$Ln(INDTXR) = -1.22 + 0.90Ln(GDPN) + 0.02D05$ (50)

          (-3.10) (32.12)   (0.24)

RSS = 0.51   Sigma = 0.14   R^2 = 0.98   R^2 adj = 0.98

Normality test = 303.13 [0.000]   LM test   = 0.58[0.965]

hetero test   = 1.38 [0.710]   ARCH test = 0.07 [0.795]

RESET   = 0.68 [0.411]   ADF   = -4.72*

T = 1979-2009

<u>Short-Run Estimates</u>

$D(LnINDTXR) = 0.94D(LnGDPN(-1)) -0.87ECINDTXR(-1) + 0.009D05$

          (4.34)   (-4.45)   (0.12)

RSS = 0.51   Sigma = 0.14   R^2 = 0.45   R^2 adj = 0.40

Normality test = 231.74 [0.000]   LM test   = 3.41[0.492]

hetero test   = 2.26 [0.812]   ARCH test = 0.10 [0.753]

RESET   = 0.30 [0.581]   T = 1981-2009

Trade Block

Export Demand Function

Long-Run Estimates

$$LnREXP = 1.72LnRGDPW - 0.49REER \qquad (52)$$
$$(50.88) \qquad (-8.05)$$

RSS = 0.96   Sigma = 0.17   R^2 = 0.94   R^2 adj = 0.94

Normality test = 1.24[0.537]   LM test = 21.63[0.000]

hetero test = 3.06 [0.548]   ARCH test = 10.32 [0.001]

RESET = 1.01 [0.314]   ADF = 3.52**

Short-Run Dynamics

$$D(LnREXP) = 0.15 - 4.25D(LnRGDPW) - 0.69D(REER) - 0.81D(LnREER(-2))$$
$$(5.54)\ (4.55) \qquad (-2.53) \qquad (-3.46)$$
$$-0.31ECEXP(-1) \qquad\qquad (53)$$
$$(-3.46)$$

RSS = 0.20   Sigma = 0.08   R^2 = 0.54   R^2 adj = 0.48

Normality test = 0.51 [0.774]   LM test = 2.38[0.667]

hetero test = 18.29 [0.019]   ARCH test = 2.02 [0.156]

RESET = 0.19 [0.667]

Import Function

Long-Run Estimates

LnRIMP = -10.47+1.35LnRGDP+0.65REER-0.26LnRPM+0.12LnCRP   (54)

      (-7.53) (13.24)   (4.04)   (-1.77)   (3.23)

RSS = 0.23   Sigma = 0.09   R^2 = 0.96   R^2 adj = 0.95

Normality test =   0.41 [0.816]   LM test   = 3.39[0.496]

hetero test   =   7.33 [0.502]   ARCH test = 0.6 [0.805]

RESET   =   0.008 [0.926]   ADF   = -4.85*

Short-Run Dynamics

D(LnRIMP) =-0.32D(LnRIMP(-1))+1.02D(LnRGDP)+0.68D(LnRGDP(-2))

        (-2.43)   (5.99)   (5.61)

        +0.86D(LnREER)-0.70D(LnRPM(-1))+0.18D(LnCRP(-2))

        (3.82)   (-3.50)   (2.17)

        +0.10D(LnWREM)-0.78ECIMP(-1)   (55)

        (2.10)   (-4.46)

RSS = 0.11   Sigma = 0.07   R^2 = 0.81   R^2 adj = 0.75

Normality test =   0.04 [0.982]   LM test   = 2.70[0.610]

hetero test   = 14.79 [0.540]   ARCH test = 0.0008 [0.977]

RESET   = 3.70 [0.054]

Key Findings

- In agriculture sector infrastructure, water availability and labour are the key determinants in the long-run, while infrastructure and availability of credit enhances the agri: activities in the short-run.

- In manufacturing sector, labour, infrastructure, import of industrial machinery and raw material are the key factors in the long-run. However, in the short-run infrastructure and raw material plays a dominant role.

- The contribution of services sector is significant and is determined by the real aggregate demand for in the long run as well as in the short-run.

- RPC is significant and is determined by the RYd in the long-run (with MPC of 0.93). In the short-run again lagged RYd exerts positive impact on RPC.
- GC is determined by Dev: expenditures and GR in the long-as well as in the short-run.
- PI is significantly determined by RY, RIR, GI and PRC in the long-run.
  - Among all, RY plays a dominant role.
  - GI has crowding-in impact.
  - PRC affect PI positively.
  - Role of interest rate is weak
    - In the short-run lagged RY plays a leading role, GI has crowding-in effect and the FDI also plays crowding in role in case of PI.

- In the monetary sector, RGDP and R influences RMd significantly in the long-run as well as in the short-run.
- The interest rate is significantly determined by Ms and policy discount rate in the long-as-well as in the short-run. The pass-through effect of Dis: rate is positive to R (i.e. 0.55 in long-run and over all 0.57 in short-run)
- Ms, real GDP, R and FP are the major determinants of general price level in the long-run. Among these factors the impact of Ms is much larger (i.e. 0.43) than that of FP (i.e. 0.28) and the R (.i.e. 0.01) in the long-run.
- In the short-run, the overall impact of FP on general price level > Ms and R. Furthermore, expected inflation is another major factor influences general price level in the short-run

- In the fiscal sector nominal GDP is the major determinant of direct tax revenue and indirect tax revenue in the long-run and in the short-run.
  - Direct tax Revenue
    - Long run elasticity = 1.24
    - Short-run elasticity = 0.64
  - Indirect Tax Revenue
    - Long-run elasticity = 0.90
    - Short-run elasticity = 0.94

- Foreign income and REER are the main determinants of exports in the long-run as well as the in the short-run.
- Domestic income, REER, RPM and PSC are the main factors influencing imports in the long-run. In the short-run, besides real income, REER, RPM, PSC worker's remittances also affects the imports.
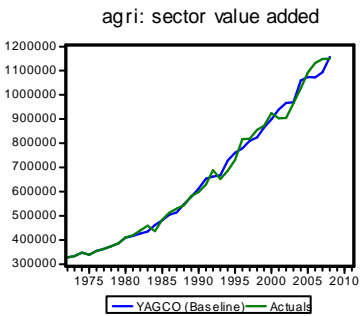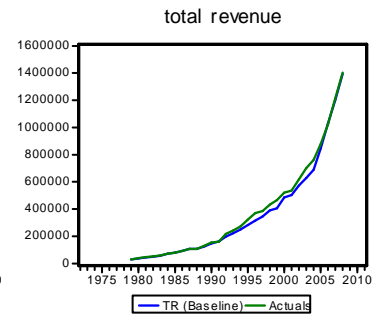
Model's Performance Evaluation

The estimated equations have been evaluated using mean absolute percentage error (MAPE) and Theil's inequality forecasting criteria.

The results of both statistics suggest that the model is able to track the historical values of all the endogenous variables. Below Table presents the results:

Table 1: In-Sample Forecast Results

Name of variable	MAPE	U-stat
Value Added in Agriculture Sector	0.217	0.001
Value added in Manufacturing Sector	0.388	0.002
Value Added in Services Sector	0.264	0.002
Private Real Consumption	0.22	0.001
Government Consumption	0.83	0.005
Private Investment	0.52	0.003
Real money Balances	0.50	0.003
short-term interest rate	19.87	0.09
Price Equation	0.53	0.003
Direct tax revenue	1.36	0.008
Indirect tax revenue	0.65	0.006
Exports of goods & services	0.94	0.006
Imports of goods and services	0.58	0.004

Production Block	
Stochastic equations **Identity**	Ya = F(La, DCa, TW, RDL, D90) Ym = F(Lm, DCm, RDL, MM, Ya) Ys = F (RAD, D90) GDP = Ya+Ym+Ys
Aggregate Demand Block	
Stochastic equations **Identity** ●	PC =F(RYd, RDR*D00) GC = F (EXDEV/GDP, GR) PI = F (RY, RIR, CRP/GDP, GI) Y = A+(X-M) A= C+I+G C = PC + GC GC= EXDEV+EXCD I = PI + GI Y = C+I+G+X-M+ Change in inventories Yd = (NGDP-TDR+WR-CPS)/CPI
Fiscal Block	
Stochastic equations **Identity**	DTXR = F (GDPN, D04) INDTR = F (GDPN, D05) BD = (GEX – GR) GR = (DTR + INDTR +NTR) GEX = (EXCUR + EXDEV + EXCD)
Monetary Block	
Stochastic equations	RM2 = F (GDP, OC, D05) CMR = F(MS/P, DISR, D03) P = F (M2, OC, PF, D03)
Trade Block	
Stochastic equations **Identity**	REXP = F (RGDPW, REER) RIMP = F (GDP, REER, RPM, CRP) TB = REXP-RIMP

budget deficit	aggregate consumption	consumer price index	direct tax revenue	exports of goods and services
BD (Baseline) — Actuals	CONS (Baseline) — Actuals	CPI (Baseline) — Actuals	DTXR (Baseline) — Actuals	EXPO (Baseline) — Actuals

real gdp	government consumption	imports of goods and services	indirect tax revenue	real money balances (m2)
GDPR (Baseline) — Actuals	GOVC (Baseline) — Actuals	IMPO (Baseline) — Actuals	INDTXR (Baseline) — Actuals	MDM2 (Baseline) — Actuals

short-term interest rate	real private consumption	private investment	trade balance	total revenue
ONIR (Baseline) — Actuals	PC (Baseline) — Actuals	PVTI (Baseline) — Actuals	TBAL (Baseline) — Actuals	TR (Baseline) — Actuals

agri: sector value added	manuf: sector value added	services sector value added
YAGCO (Baseline) — Actuals	YINCO (Baseline) — Actuals	YSRCO (Baseline) — Actuals

Policy Simulation

- To simulate, we assume:

    - 10% increase in GI

    - 1% reduction in Disc: rate

10% increase in GI (% deviations from baseline)

	2010	2011	2012	2013	average
Agri:value added	0	0	0	0	0
Manuf: value added	0	0	0	0	0
Services value added	0	0	0	0	0
Private consumption	0.03	-0.97	-0.5	-1.0	-0.61
Private investment	6.23	3.93	5.59	4.84	5.15
Direct tax revenue	0	0	0	0	0
Indirect tax revenue	0	0	0	0	0
inflation	1.23	0.68	1.3	1.24	1.11
Real GDP	1.46	0.79	1.53	1.47	1.13
Exports of goods and services	1.01	0.55	1.05	1.02	0.91
Import of goods and services	2.04	1.09	2.06	2.03	1.81

- No change observed in supply side.
- On average RPC decreases by 0.61% over the baseline values
- Private investment increases by 5.15 % on average
- Inflation increase by 1.11% on average
- Real GDP increases by 1.13% over the baseline values
- Exports increases by 0.90% over the baseline values
- Imports increases by 1.81% over the baseline values
  - Reduction in Cons: leads to increase in Savings
  - Increase in PI leads to increase in output.
  - Increase in domestic prices and incomes leads to increase in imports
  - Increase in GI leads to promote growth, but it worsens trade balance.

1% reduction in Disc: Rate

	2010	2011	2012	2013	average
Agri:value added	0	0	0	0	0
Manuf: value added	0	0	0	0	0
Services value added	0	0	0	0	0
Private consumption	-0.01	-0.06	-0.02	-0.04	-0.033
Private investment	0.08	-0.06	0.04	-0.02	0.01
Direct tax revenue	0	0	0	0	0
Indirect tax revenue	0	0	0	0	0
inflation	0.07	0.03	0.06	0.04	0.05
Real GDP	0.02	-0.03	0	-0.02	-0.008
Exports of G&S	0.06	0.02	0.04	0.03	0.04
Import of G&S	0.05	-0.03	0.01	-0.01	0.005

- Negative effect on RPC
- Positive effect on PI, inflation, exports and imports.
- Positive effect on trade balance
- Negative effect on real gdp

THANK YOU