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GDP Forecast for Australia

Saraogi, Ravi

Madras School of Economics, Chennai, Tamil Nadu, India

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GDP Forecast for Australia

How high will the Kangaroos jump?

Ravi Saraogi

5/26/2008

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Australia: An Introduction

The Commonwealth of Australia is a country in the southern hemisphere comprising the mainland of the world's smallest continent, the major island of Tasmania, and a number of other islands in the Indian and Pacific Oceans.^{N4} The neighbouring countries are Indonesia, East Timor, and Papua New Guinea to the north, the Solomon Islands, Vanuatu, and New Caledonia to the north-east, and New Zealand to the south-east. Australia is the only country that is also a continent.

Australia has a prosperous, Western-style mixed economy, with a per capita GDP slightly higher than that of the UK, Germany, and France in terms of purchasing power parity. The country was ranked third in the United Nations' 2007 Human Development Index and sixth in The Economist worldwide quality-of-life index 2005. The absence of an export-oriented manufacturing industry has been considered a key weakness of the Australian economy. More recently, rising prices for Australia's commodity exports and increasing tourism have made this criticism less relevant. Nevertheless, Australia has the world's fourth largest current account deficit in absolute terms (in relative terms it is more than 7% of GDP). This is considered problematic by some economists, especially as it has coincided with the high terms of trade and low interest rates that make the cost of servicing the foreign debt low.

The Hawke Government started the process of economic reform by floating the Australian dollar in 1983, and partially deregulating the financial system. The Howard government continued the process of microeconomic reform, including a partial deregulation of the labour market and the privatisation of state-owned businesses, most notably in the telecommunications industry. The indirect tax system was substantially reformed in July 2000 with the introduction of a 10% Goods and Services Tax (GST), which has slightly reduced the heavy reliance on personal and company income tax that characterises Australia's tax system.

At January 2007, there were 10,033,480 people employed, with an unemployment rate of 4.6%. Over the past decade, inflation has typically been 2–3% and the base interest rate 5–6%. The service sector of the economy, including tourism, education and financial services, constitutes 69% of GDP. Agriculture and natural resources constitute 3% and 5% of GDP but contribute substantially to export performance. Australia's largest export markets include Japan, China, the US, South Korea and New Zealand.

The snap shot given below should get the reader acquainted with the Australian economy.

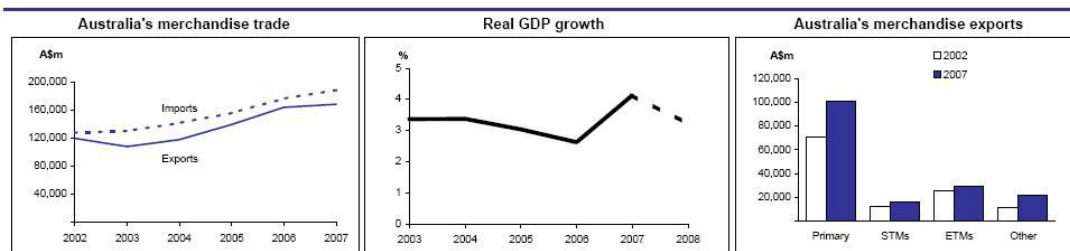
Australia: Fact Sheet

General information:

Fact sheets are updated biannually; May and September

Capital:	Canberra	Head of State:	H.M. Queen Elizabeth II, represented by the
Surface area:	7,692 thousand sq km		Governor-General Major General Michael Jeffery
Official language:	English	Head of Government:	Prime Minister The Hon Mr Kevin Rudd
Population:	21.1 million (2007)		
Exchange rate:	A\$1 = US\$ 0.9131 (Feb 2008)		

<i>Recent economic indicators:</i>	2003	2004	2005	2006	2007(a)	2008(b)
GDP (US\$bn) (current prices):	527.7	640.3	713.9	757.5	910.9	1,046.8
GDP PPP (US\$bn) (c):	600.1	636.3	672.5	713.1	760.8	801.0
GDP per capita (US\$):	26,364	31,610	34,741	36,325	43,178	49,271
GDP per capita PPP (US\$) (c):	30,112	31,551	32,898	34,375	36,258	37,701
Real GDP growth (% change YOY):	3.4	3.4	3.0	2.6	4.1	3.2
Current account balance (US\$m):	-28,566	-38,895	-41,050	-41,470	-56,517	-65,574
Current account balance (% GDP):	-5.4	-6.1	-5.8	-5.5	-6.2	-6.3
Goods & services exports (% GDP):	17.9	18.1	19.4	20.8	20.0	20.8
Inflation (% change YOY):	2.4	2.6	2.8	3.3	3.0	3.5



Australia's trade and investment relationships (d):

Major Australian exports, 2007 (A\$m) (e):		Major Australian imports, 2007 (A\$m) (e):	
Coal	20,753	Crude petroleum	14,648
Iron ore	16,112	Passenger motor vehicles	13,849
Non-monetary gold	11,359	Refined petroleum	8,235
Crude petroleum	7,966	Computers	6,904
Aluminium ores (incl. alumina)	6,058	Medicaments (incl. veterinary)	6,437

Australian merchandise trade, 2007:	
Exports (A\$m):	168,055
Imports (A\$m):	187,796
Total trade (exports + imports) (A\$m):	355,851
Merchandise trade deficit (A\$m):	19,741

Australia's main export destinations, 2007 (e):		Australia's main import sources, 2007 (e):	
1 Japan	18.9%	1 China	15.5%
2 China	14.1%	2 United States	12.6%
3 Republic of Korea	8.0%	3 Japan	9.6%
4 United States	6.0%	4 Singapore	5.6%
5 New Zealand	5.6%	5 Germany	5.2%

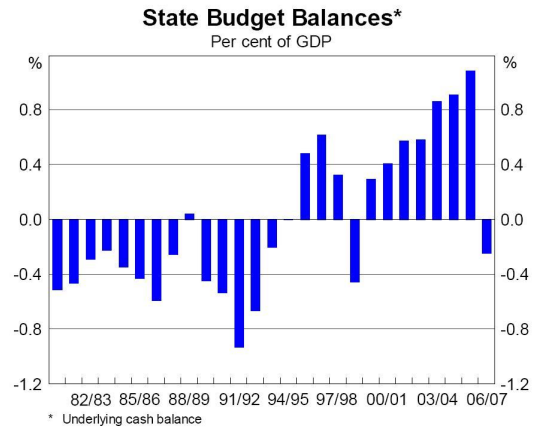
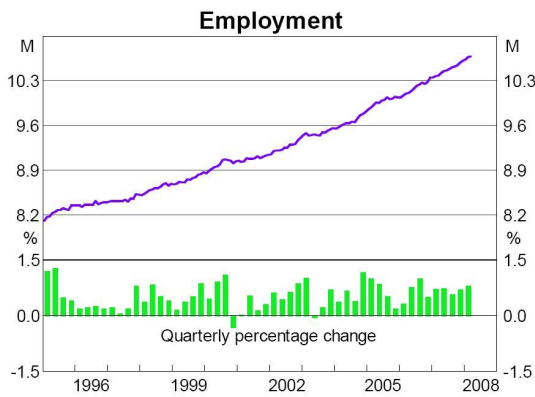
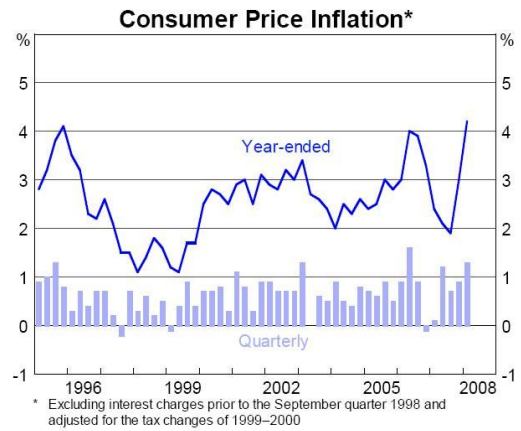
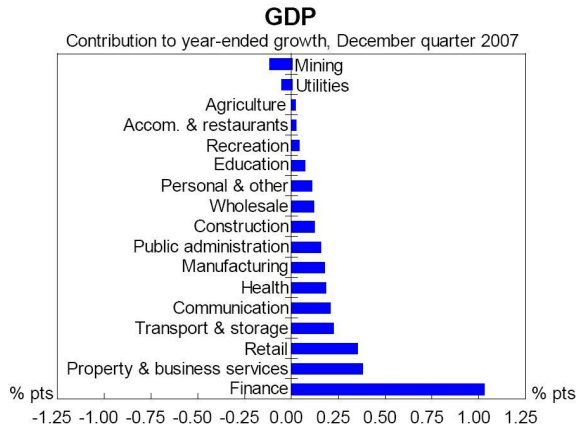
Australia's trade in services, 2007:	
Exports of services (A\$m):	48,042
Imports of services (A\$m):	46,054
Services trade surplus (A\$m):	1,988

Australia's investment links, as at 31 Dec 2007:	
Level of Australian investment abroad (A\$m):	884,365
Level of foreign investment in Australia (A\$m):	1,621,192

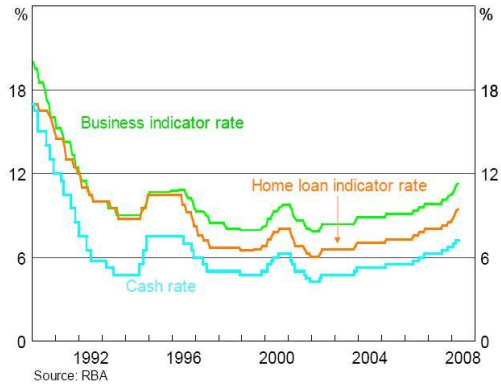
Source: Compiled by the Market Information and Analysis Section, DFAT, using the latest data from ABS, the IMF and various international sources. (a) All recent data subject to revision (b) IMF forecast (c) PPP is purchasing power parity (d) Total may not add due to rounding (e) Merchandise Trade

Australian Economy: A Graphical Tour

Source: Reserve Bank of Australia

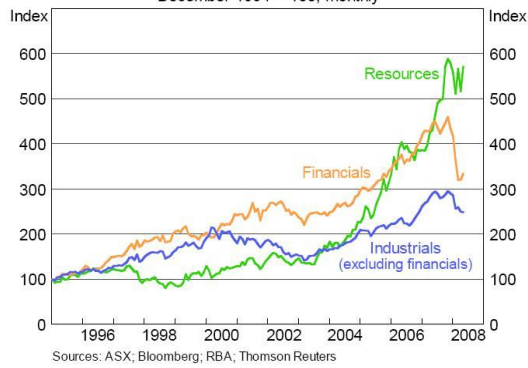


Nominal Interest Rates



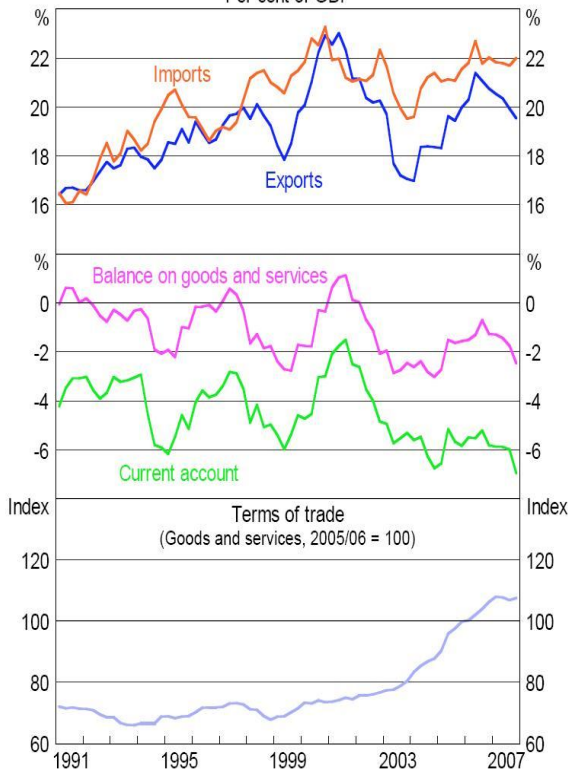
Australian Share Prices

December 1994 = 100, monthly



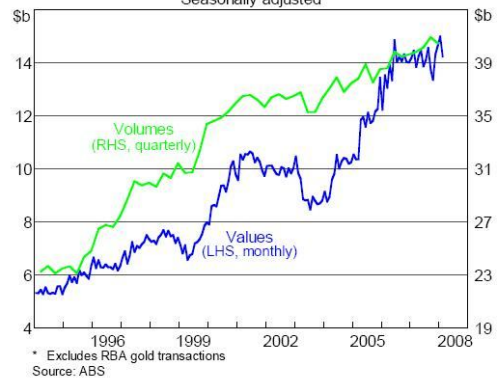
Balance of Payments*

Per cent of GDP



Merchandise Exports*

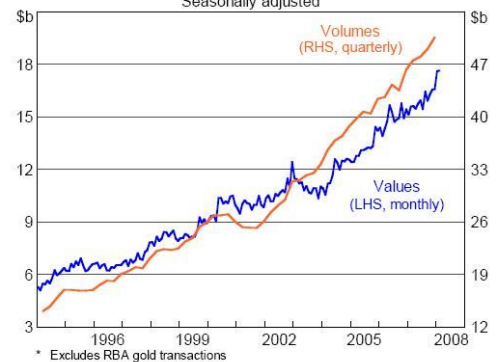
Seasonally adjusted



* Excludes RBA gold transactions
Source: ABS

Merchandise Imports*

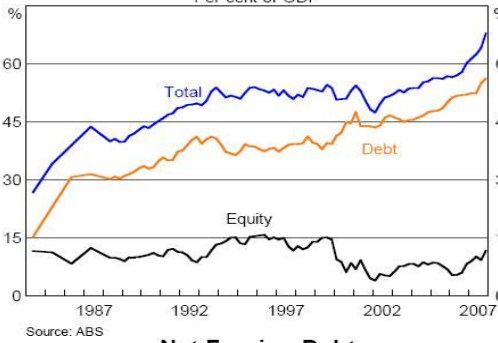
Seasonally adjusted



* Excludes RBA gold transactions

Net Foreign Liabilities

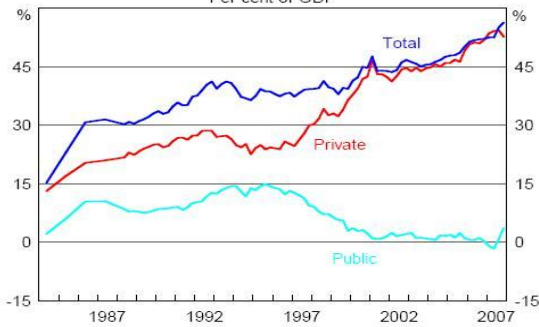
Per cent of GDP



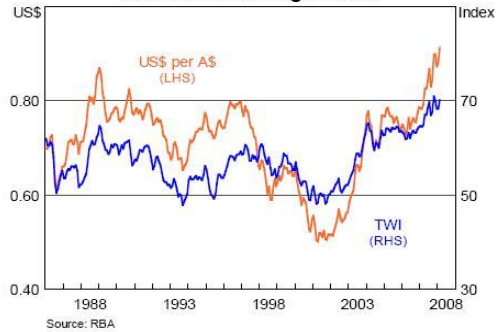
Source: ABS

Net Foreign Debt

Per cent of GDP



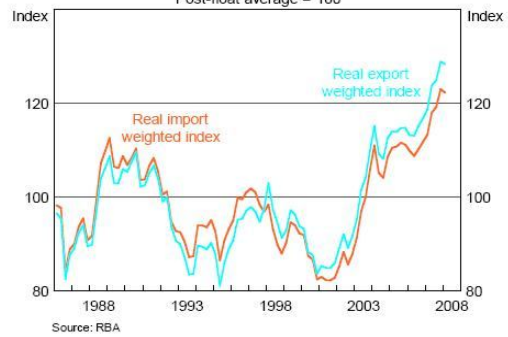
Nominal Exchange Rates



Source: RBA

Real Exchange Rates

Post-float average = 100



Source: RBA

The Model

We are estimating a Vector Auto Regressive (VAR) model to forecast the quarterly growth rates in the GDP (at constant 2000 USD) of Australia¹, which has some obvious benefits over a pure simultaneous equation system. In the case of simultaneous equation systems, some variables are treated as endogenous and some as exogenous or predetermined (exogenous plus lagged endogenous). Before we estimate such models, we have to make sure that the equations in the system are identified (either exactly or over-). This identification is often achieved by assuming that some of the predetermined variables are present only in some equations. This decision is often subjective and has been severely criticized by Christopher Sims². According to Sims, if there is true simultaneity among a set of variables, they should all be treated on an equal footing; there should not be any a priori distinction between endogenous and exogenous variables. It is in this spirit that Sims developed his VAR model which we use for our purpose.

All the variables in a VAR model are endogenous and we can apply the usual OLS procedure³. The model which we will be using is,

$$Y_t = \alpha + \beta HCl_{t-i} + \gamma PCl_{t-i} + \eta Bl_{t-i} + \theta ES_{t-i} + \epsilon_t$$

where, Y_t = Quarterly growth rate in GDP (at constant 2000 US\$)

α = Intercept term

HCl_{t-i} = Human capital index with i^{th} time period lag

PCl_{t-i} = Physical capital index with i^{th} time period lag

Bl_{t-i} = Banking index with i^{th} time period lag

ES_{t-i} = External sector index with i^{th} time period lag

$\beta, \gamma, \eta, \theta$ = Regression coefficients

ϵ_t = Error term

In the above model, we estimate human capital index, physical capital index, banking index and external sector index with the help of 16 variables⁴ as described below -

Human Capital Index

$$HCl_t = a (PG) + b (DR) + c (Edu)$$

¹ Sample data is from 1960:1 to 2006:4 and the forecast is up to 2050:4

² C. A. Sims, "Macroeconomics and Reality," *Econometrica*, vol. 48, 1980, pp. 1-48.

³ Gujarati, "Time Series Econometrics: Forecasting", *Basic Econometrics*, pp 853

⁴ For the WDI definitions of the variables used in the model, refer Appendix A

Where,

a,b,c are weights ($a + b + c = 1$ and $a=b=c$)

PG= Quarterly population growth rates in per cent

DR= Quarterly dependency ratio

Edu= Quarterly govt. expenditure on education as a per cent of quarterly GDP (at current US\$)

Physical Capital Index

$$PCI_t = d (GFCF_{t-1}) + e (FDI_{t-1}) + f (M Cap)$$

Where,

d,e,f are weights ($d + e + f = 1$ and $d=e=f$)

GFCF_{t-1} = Quarterly gross fixed capital formation as a per cent of quarterly GDP (at current US\$) with one time period lag

FDI_{t-1} = Quarterly net foreign direct investment as a per cent of quarterly GDP (at current US\$) with one time period lag

M Cap = Quarterly stock market capitalization as a per cent of quarterly GDP (at current US\$)

Banking Index

$$BI_t = g (I) + h (R) + i (L) + j (CR)$$

g, h, i, j are weights ($g + h + i + j = 1$ and $g=h=i=j$)

I = Quarterly prime lending rate

RR = Quarterly bank liquid reserves to bank assets ratio (ratio)

L= Quarterly banks non performing loans to total loans (ratio)

CR = Quarterly bank capital to asset ratios

External Sector Index

$$ESI_t = k (REER) + l (CA) + m (T) + n (F)$$

Where,

k, l, m, n are weights ($k + l + m + n = 1$ and $k=l=m=n$)

REER= Quarterly Real Effective Exchange Rate (REER)

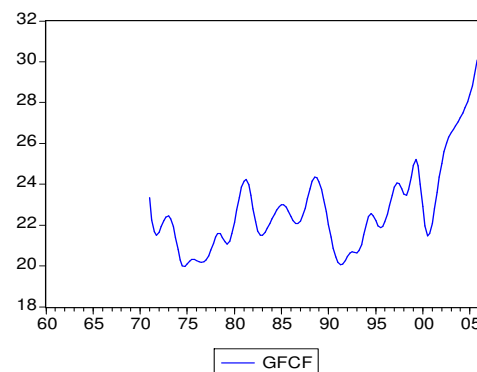
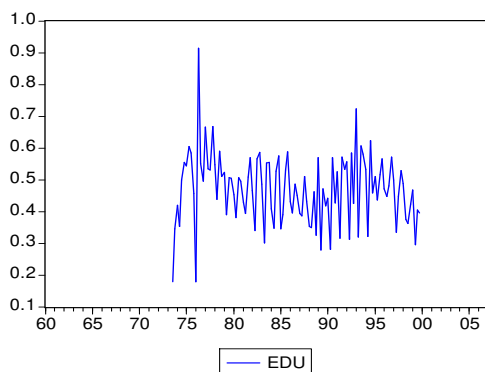
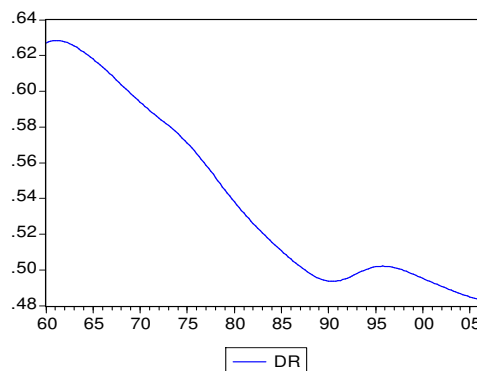
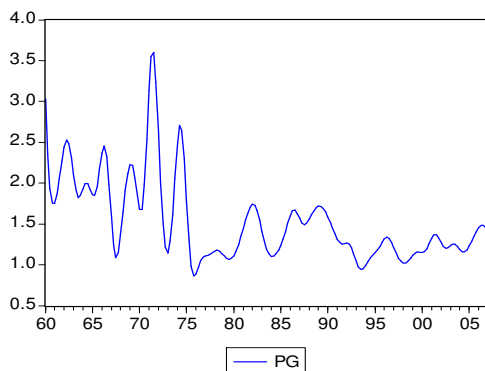
CA= Quarterly capital account balance as a per cent of quarterly GDP (at current US\$)

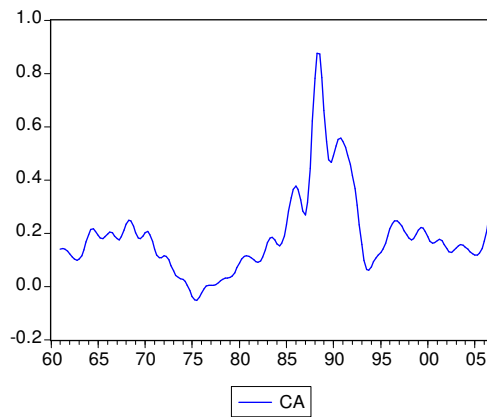
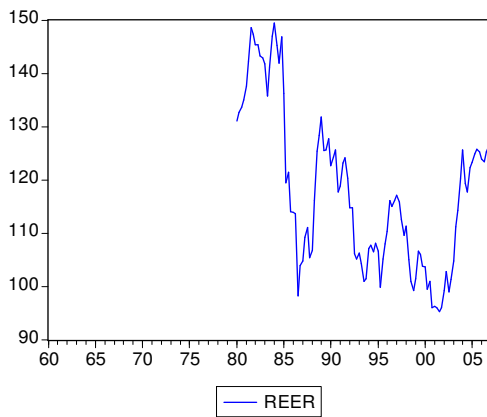
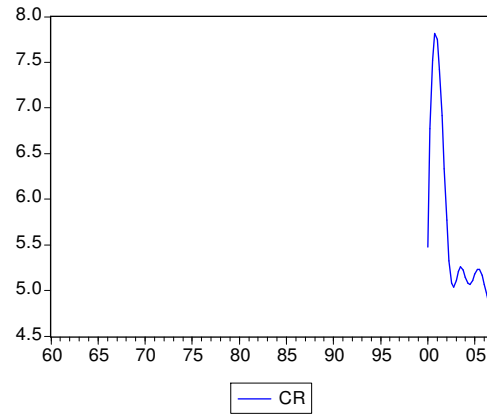
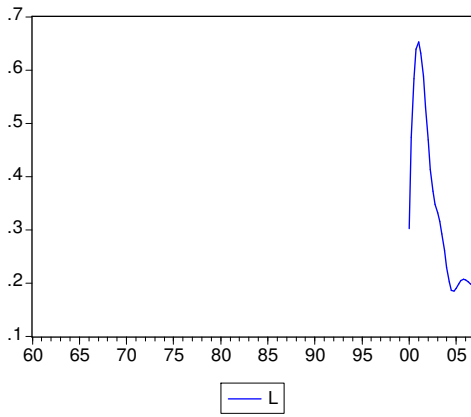
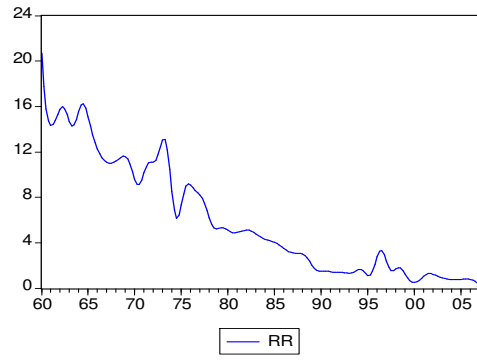
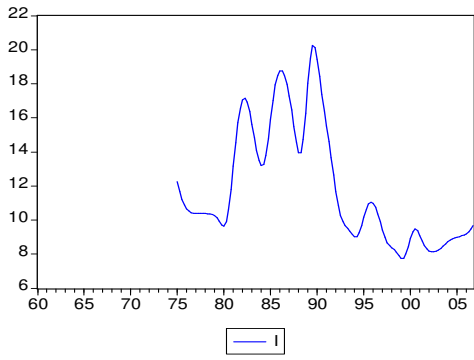
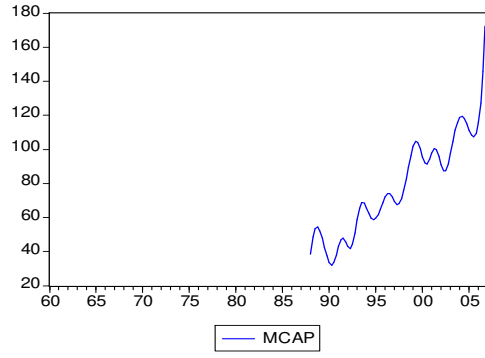
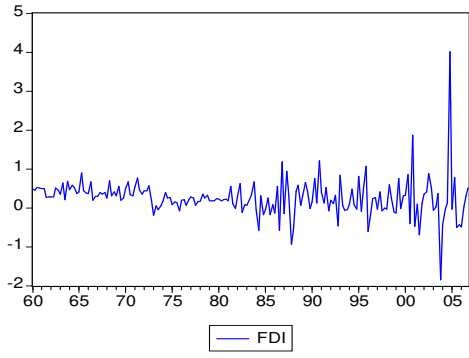
T= Quarterly trade balance in goods and services as a per cent of quarterly GDP (at current US\$)

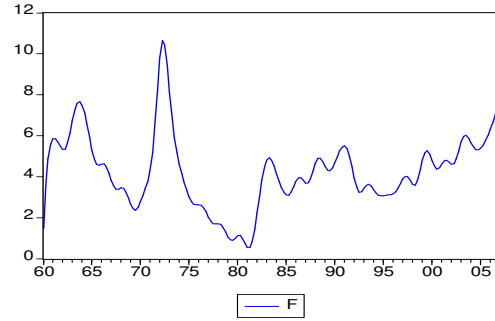
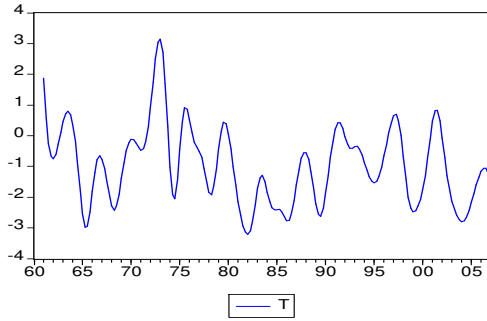
F= Quarterly forex reserves as a per cent of quarterly GDP (at current US\$)

The Variables

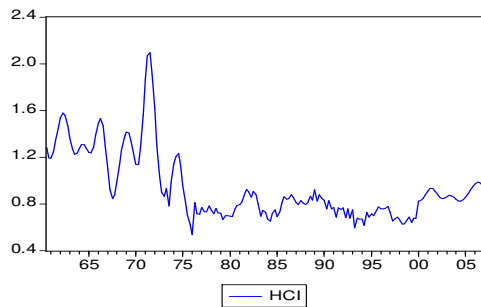
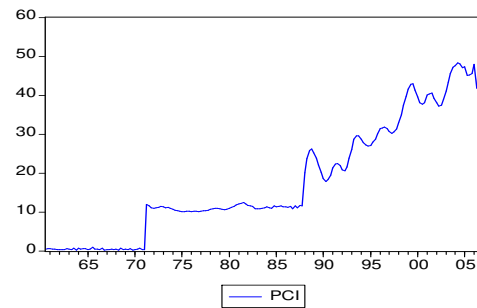
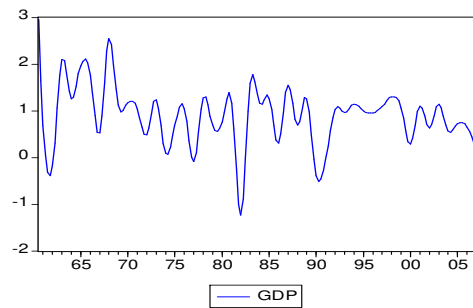
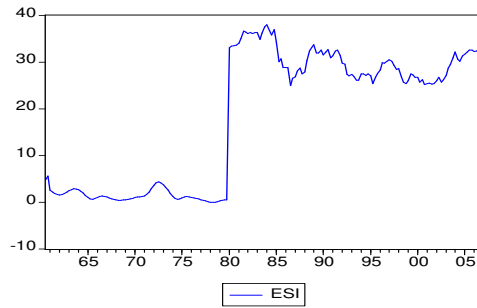
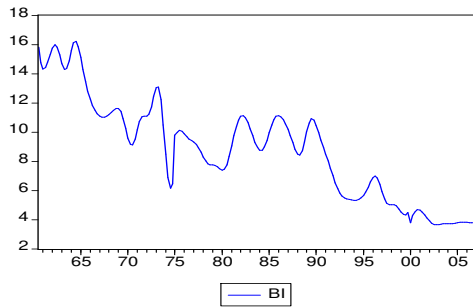
S.No	Variable Name	Variable Symbol	Units	Frequency	Actual Series From
1	GDP Growth Rate (in constant 2000 US\$)	Y	%	Quarterly	1960:1 to 2006:4
2	Population Growth Rate	PG	%	Quarterly	1960:1 to 2006:4
3	Dependency Ratio	DR	Ratio	Quarterly	1960:1 to 2006:4
4	Education on Expenditure (% of current GDP)	Edu	%	Quarterly	1973:3 to 1994:4
5	Gross Fixed Capital Formation (% of current GDP)	GFCF	%	Quarterly	1971:1 to 2005:4
6	Net Foreign Direct Investment (% of current GDP)	FDI	%	Quarterly	1960:1 to 2006:4
7	Market Capitalization (% of current GDP)	Mcap	%	Quarterly	1988:1 to 2006:4
8	Prime Lending Rate	I	%	Quarterly	1975:1 to 2006:4
9	Bank Liquid Reserves to Bank Assets Ratio	RR	Ratio	Quarterly	1960:1 to 2006:4
10	Banks Non Performing Loans to Total Loans	L	Ratio	Quarterly	2000:1 to 2006:4
11	Bank Capital to Asset Ratio	CR	Ratio	Quarterly	2000:2 to 2006:4
12	Real Effective Exchange Rate	REER	Index	Quarterly	1980:2 to 2006:4
13	Capital Account Balance (% of current GDP)	CA	%	Quarterly	1961:1 to 2006:4
14	Trade Balance in Goods and Services (% of current GDP)	T	%	Quarterly	1961:1 to 2006:4
15	Forex Reserves (% of current GDP)	F	%	Quarterly	1960:1 to 2006:4







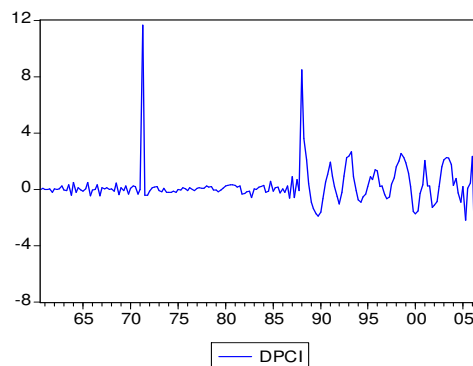
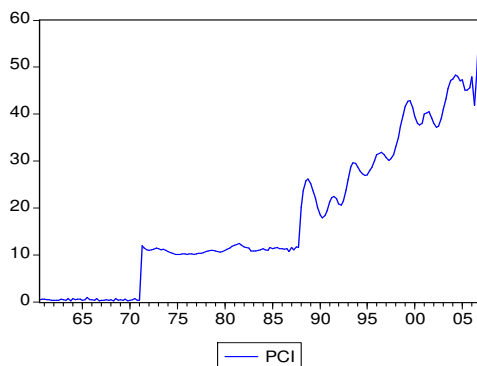
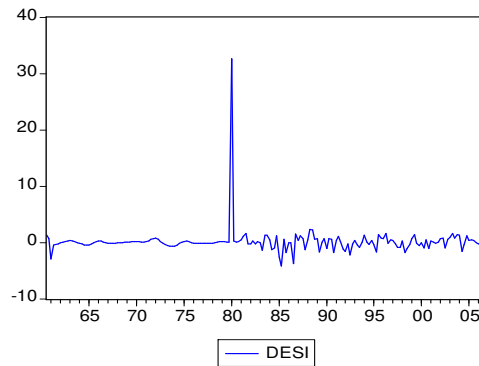
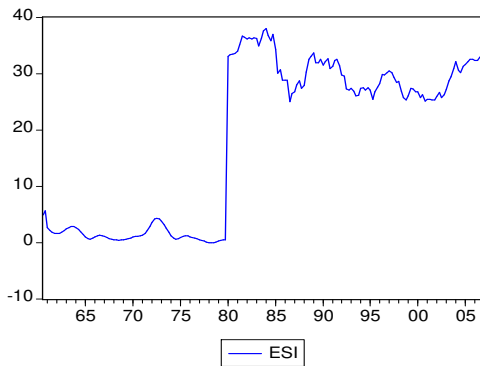
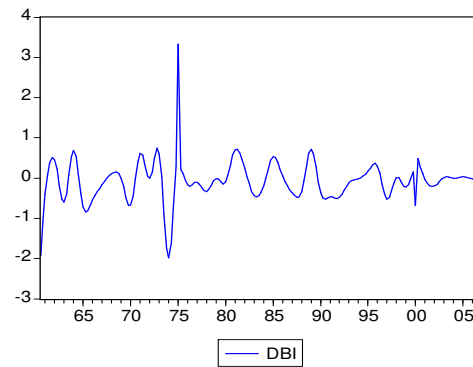
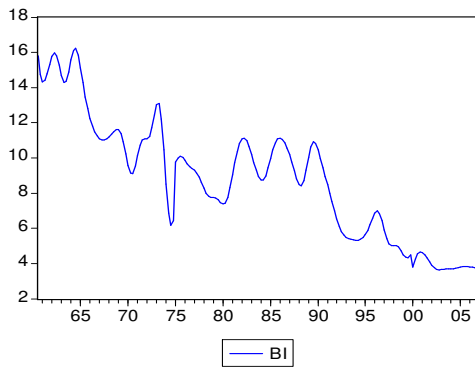
The following graphs are for the initial indices that were constructed with the use of appropriate weights (equal weights have been given to each variable within an index). As a visual examination would suggest, apart from the series for GDP and perhaps HCI, none of the series appear to be stationary.



- BI = Banking Index
- ESI = External Sector Index
- GDP = GDP Growth Rate
- HCI = Human Capital Index
- PCI = Physical Capital Index

For further information about the stationarity of the series, the augmented dickey fuller test was applied to each of the five series to and appropriate transformation was used to convert non stationary data into stationary data.

S.No.	Data Series	Stationary	Transformation Used for Stationarity
1	GDP	Yes	Already stationary
2	HCI	Yes	Already stationary
3	PCI	No	First difference transformation
4	ESI	No	First difference transformation
5	BI	No	First difference transformation



BI= Banking Index (Non Stationary)
 ESI=External Sector Index (Non Stationary)
 PCI=Physical Capital Index (Non Stationary)

DBI = First difference of BI (Stationary)
 DESI=First difference of ESI (Stationary)
 DPCI=First difference of PCI (Stationary)

After making the data stationary, we estimated an unrestricted VAR type with 3 lag intervals. The lag interval was selected based on the following criterion-

VAR Lag Order Selection Criteria

Endogenous variables: DBI DESI DPCI GDP HCI

Exogenous variables: C

Sample: 1960:3 2006:4

Included observations: 183

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1107.402	NA	0.131074	12.15739	12.24509	12.19294
1	-673.0682	840.1859	0.001495	7.683805	8.209951	7.897078
2	-484.3979	354.6589	0.000250	5.895059	6.859659	6.286058
3	-368.0067	212.4297*	9.23E-05*	4.896249*	6.299303*	5.464975*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The VAR model has been outlined below-

Eq1: $dbi = F(dbi, desi, dpci, gdp, hci)$

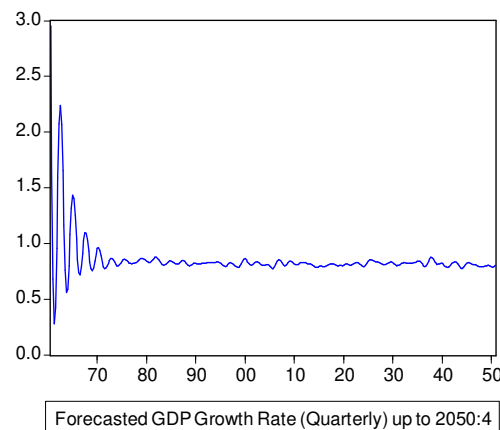
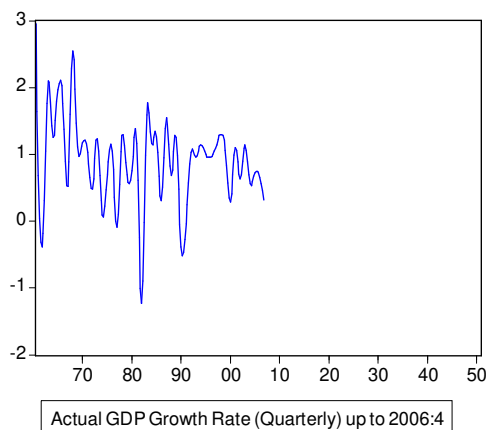
Eq2: $desi = F(dbi, desi, dpci, gdp, hci)$

Eq3: $dpci = F(dbi, desi, dpci, gdp, hci)$

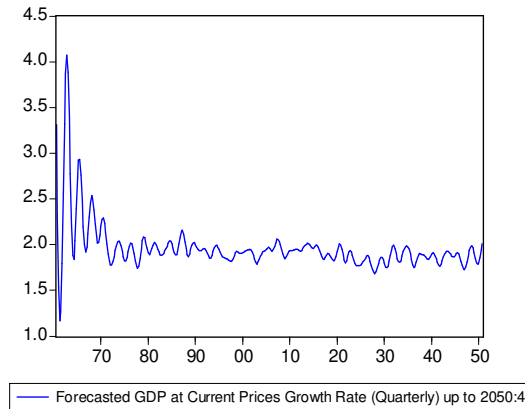
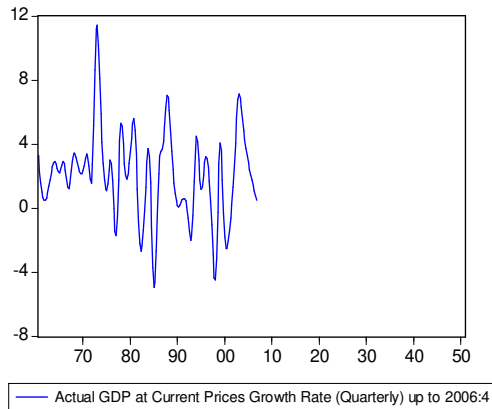
Eq4: $gdp = F(dbi, desi, dpci, gdp, hci)$

Eq5: $hci = F(dbi, desi, dpci, gdp, hci)$

The quarterly estimates were obtained up to 2050:4 with the following results



As we can see, the growth rate in quarterly GDP (at constant 2000 US\$) stabilises in the range of 0.5 to 1 per cent. The above model was also estimated with the quarterly growth rate of GDP at current prices with the following results-



The growth rate for quarterly GDP at current prices stabilizes at around 1.9 per cent with minor fluctuations on either side. The above result however should be accepted with the several caveats. The data has not been checked for problems of autocorrelation, multicollinearity and heteroscedasticity. The accuracy of the estimate may have been compromised due to part availability of some data series and the indexation technique adopted in such cases. The weights used for indexation were assumed to be equal. This can however be challenged on theoretical grounds.

Appendix A – Variable Description⁵

Population growth (quarterly %): Quarterly Annual population growth rate. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, which are generally considered part of the population of the country of origin.

Dependency Ratio (dependents to working-age population): Dependency ratio is the ratio of dependents--people younger than 15 or older than 64--to the working-age population--those ages 15-64. For example, 0.7 means there are 7 dependents for every 10 working-age people.

Gross fixed capital formation (% of GDP at current US\$): Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial

⁵ Data for the below mentioned variables was collected for the time period 1960:1 to 2006:4 from www.economy.com (Moody's Economy)

buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation.

Net Foreign direct investment, net inflows (% of GDP at current US\$): Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows in the reporting economy and is divided by GDP.

Market capitalization of listed companies (% of GDP at current US\$): Market capitalization (also known as market value) is the share price times the number of shares outstanding. Listed domestic companies are the domestically incorporated companies listed on the country's stock exchanges at the end of the year. Listed companies do not include investment companies, mutual funds, or other collective investment vehicles.

Prime lending rate (in %): Prime lending interest rate is the rate charged by banks on loans to prime customers.

Bank liquid reserves to bank assets ratio: Ratio of bank liquid reserves to bank assets is the ratio of domestic currency holdings and deposits with the monetary authorities to claims on other governments, nonfinancial public enterprises, the private sector, and other banking institutions.

Bank nonperforming loans to total loans (ratio): Bank nonperforming loans to total gross loans are the value of nonperforming loans divided by the total value of the loan portfolio (including nonperforming loans before the deduction of specific loan-loss provisions). The loan amount recorded as nonperforming should be the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue.

Bank capital to assets (ratio): Bank capital to assets is the ratio of bank capital and reserves to total assets. Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments. Capital includes tier 1 capital (paid-up shares and common stock), which is a common feature in all countries' banking systems, and total regulatory capital, which includes several specified types of subordinated debt instruments that need not be repaid if the funds are required to maintain minimum capital levels (these comprise tier 2 and tier 3 capital). Total assets include all nonfinancial and financial assets.

Real effective exchange rate index (2000 = 100): Real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs.

Net capital account (% of GDP at current US\$): Net capital account includes government debt forgiveness, investment grants in cash or in kind by a government entity, and taxes on capital transfers. Also included are migrants' capital transfers and debt forgiveness and investment grants by nongovernmental entities. Data are in current U.S. dollars.

Net trade in goods and services (% of GDP at current US\$): Net trade in goods and services is derived by offsetting imports of goods and services against exports of goods and services. Exports and imports of goods and services comprise all transactions involving a change of ownership of goods and services between residents of one country and the rest of the world. Data are in current U.S. dollars.

Forex reserves (excluding gold, % of GDP at current US\$): Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities.

Expenditure on Education (% of GDP at current US\$): To capture the skill base, government expenditure on education as a percentage of current US\$ GDP has been computed.