



Predicting Indian GDP

And its relation with FMCG Sales

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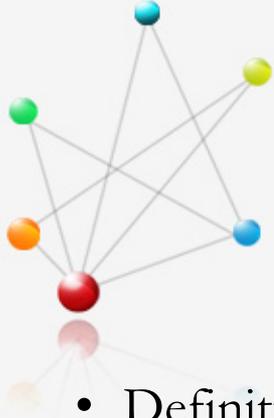
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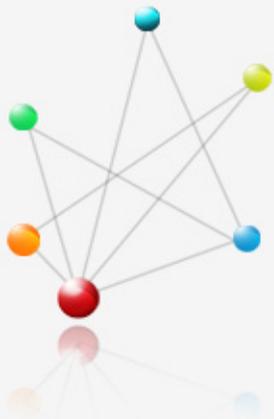


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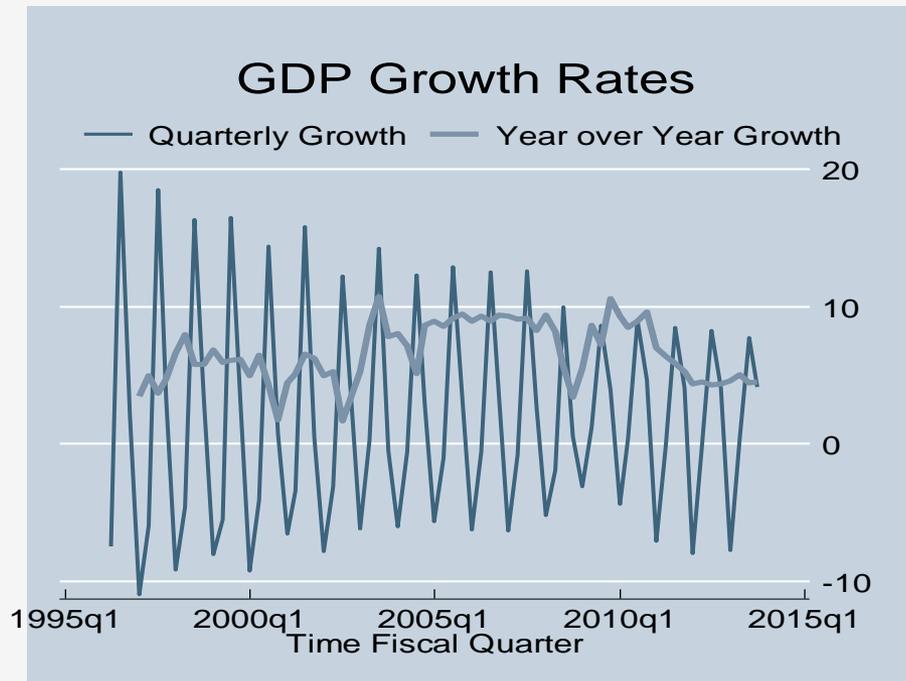
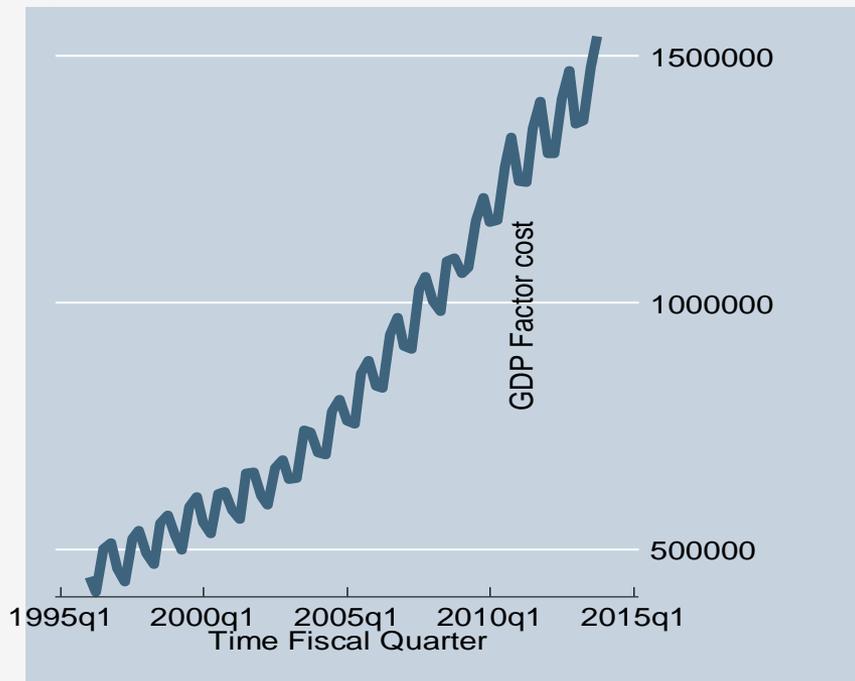


GDP – A Broad Measure of Economic Activity

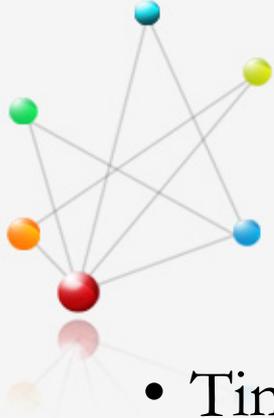
- Definition
 - The monetary value of all the finished goods and services produced within a country's borders in a specific time period, though GDP is usually calculated on an annual basis. It includes all of private and public consumption, government outlays, investments and exports less imports that occur within a defined territory.
- Why is it Essential?
 - It tells us all that is going on within the country regardless of who 'owns' the source of the economic activity
- Why does it matter?
 - Broader economic growth affects all aspects of business (and life in general, really)
 - From stock markets to demand for goods and potential labor market dynamics are all affected
- Why is GDP predictable
 - It is a backward looking measure
 - Measured after the economic activity has happened



Indian GDP growth rates are slowing, but still one of the fastest growing large economies



Models used to Predict GDP

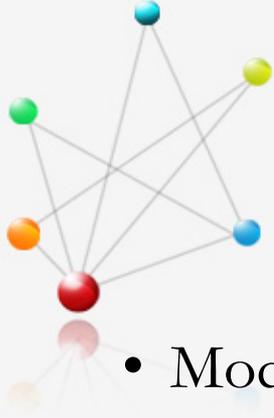


- Time Series
 - Trend Models
 - Linear
 - Quadratic
 - ARIMA
- Simultaneous Equation Models
 - Two Stage Least Squares
 - Three Stage Least Squares
- Cross Country Panel Data
 - Random Effects
 - Fixed Effects



Time Series Analysis

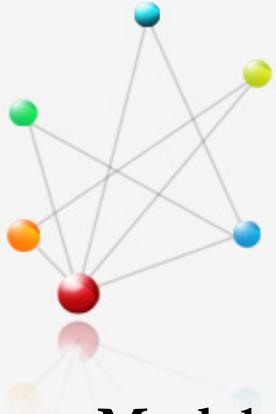
- The math is complex
- The idea is simple and intuitive
 - Past observations affect the future
 - If something (GDP, in our case) was growing at 5% last year, it is very likely that it will grow at levels close to 5% this year
- Predict growth rates, not actuals
 - Actual GDP, or indexes, tend to move in a trend
 - Thus relationships do not mean much
 - Two variables may move in the same direction, but it is the rate at which they are moving that we are interested in



Time Series Quadratic Trend Model

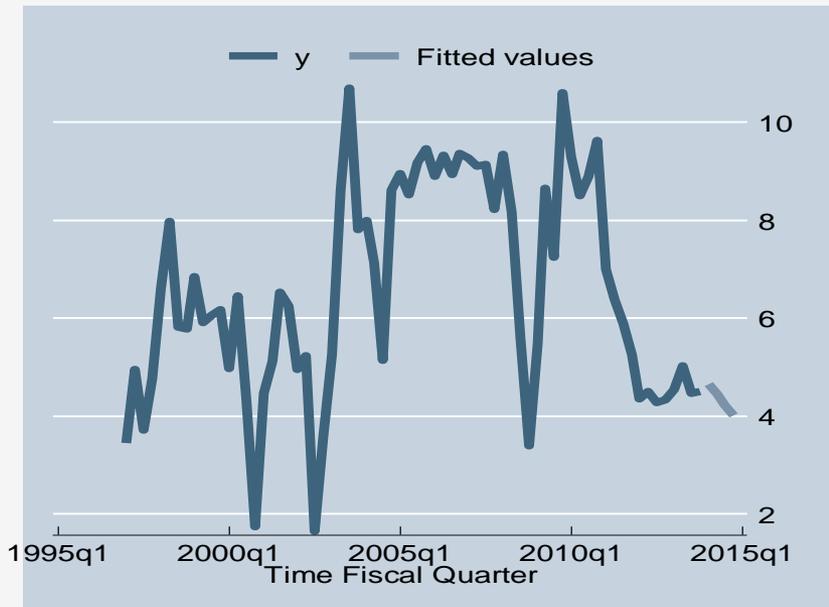
- Model basic: Real GDP growth depends only on time
- We use quarterly real GDP data from 1995
- We use the year-over-year growth to take care of seasonal effects
 - Thus real GDP growth means change in real GDP from same quarter of last year (Growth 2013Q4 = GDP 2013Q4/GDP 2012Q4 – 1)
- Time is a variable in the regression model
 - Thus, expecting a relationship between GDP to depend on the year
 - Commonly used for variables which move in one direction
 - Year over Year, real GDP has not dropped in India
- Our model
 - $\text{GDP Growth} = \beta_1 * \text{time} + \beta_2 * \text{time}^2$

Trend Model Forecast shows Downward Trend

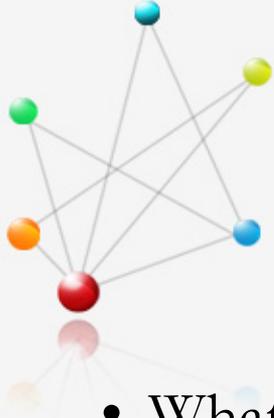


Model shows a slight downward trend in growth rates in 2014

Trend models are simple but naïve models of growth



Quarter	Growth	GDPFactorcost
2011q4	5.26	1408136
2012q1	4.36	1300221
2012q2	4.51	1299461
2012q3	4.29	1411785
2012q4	4.34	1470645
2013q1	4.55	1360757
2013q2	5.03	1366441
2013q3	4.46	1476212
2013q4	4.50	1538380
2014q1	4.65	1424066
2014q2	4.44	1427172
2014q3	4.23	1538655
2014q4	4.01	1600052



Autoregressive Integrated Moving Average

- What is ARIMA?
 - ARIMA models are, in theory, the most general class of models for forecasting a time series which can be stationarized by transformations such as differencing or logs

- The equation for ARIMA (1,1,1)

$$\hat{Y}(t) = \mu + Y(t-1) + \phi(Y(t-1) - Y(t-2)) - \theta e(t-1)$$

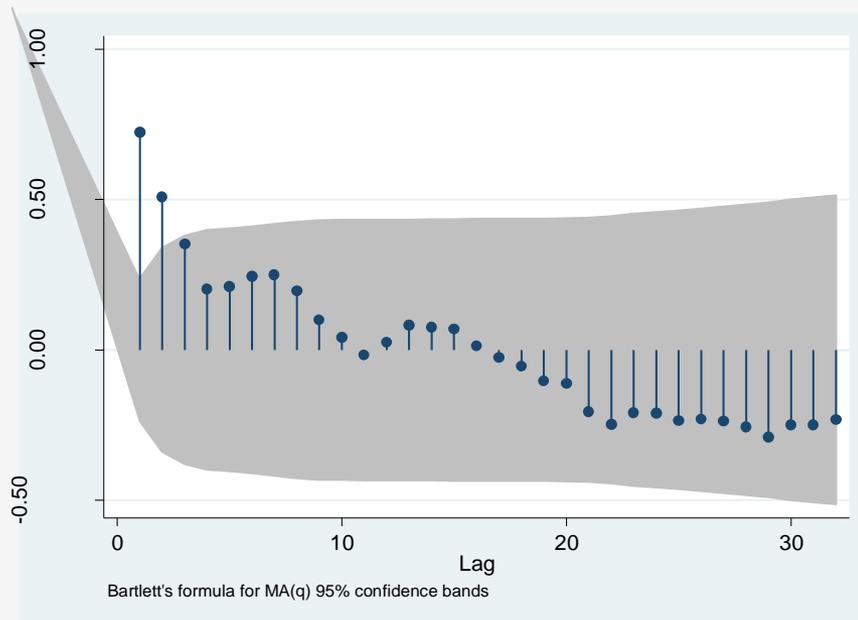
- Our model
 - Since our data is already transformed (12-month differenced growth data), we know we will not need the integration model
 - We use the ACF graph to look for AR terms



We choose a $AR(2)$ $MA(1)$ model

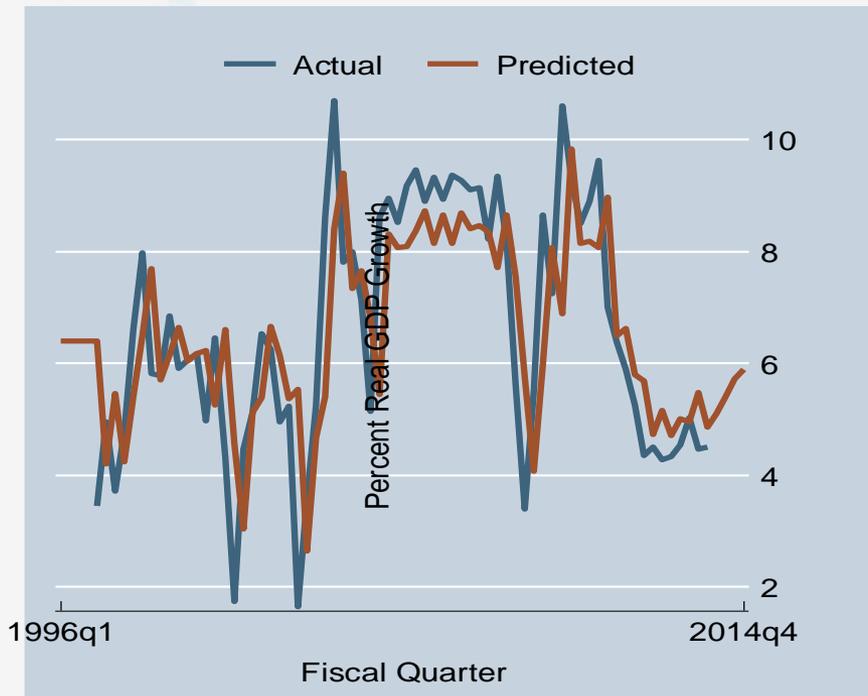
The ACF graph showed
autocorrelation of two lags

The $AR(2)$ $MA(1)$ model provided
the best fit for the GDP growth data



- This implies that best estimates are provide by
 - Moving Average of GDP with its 1st lag, and
 - GDP growth data with its 2nd lag ($AR(2)$) provides best estimates
 - $AR(1)$ does not provide any insights as we are using $MA(1)$

The ARIMA Model shows a bounce in GDP growth rates in the next 4 quarters

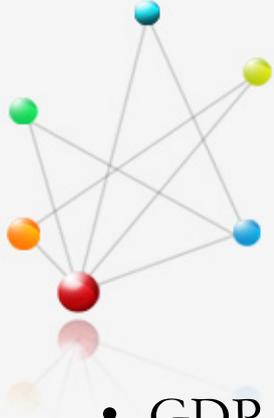


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2013q4	4.50	1538380
2014q1	5.11	1430250
2014q2	5.42	1440436
2014q3	5.73	1560791
2014q4	5.89	1628988



Time Series Models do not Predict Sharp Changes but are very Robust

- Very important now due to regime change
- Simultaneous Equation Models of the Economy can predict sharp changes if the correct leading indicators are chosen
- However, they are not usually as robust as *ARIMA*
- Effect of political regime change will only be felt after 2 quarters of change
- See effects of policy change on GDP in Q3 2014 at the earliest
- We will keep updating our models to reflect these changes



The SEM Model

- GDP in four parts
 - Manufacturing GDP
 - Agricultural GDP
 - Construction GDP
 - Service Sector GDP
 - Forecasted separately
 - Different variables are relevant
 - Different time frames are important
 - May be useful for further analysis
- The model can explain between 50% to 85% of sectoral GDP growth
- ARIMA performs better but use SEM in future to reflect policy changes



Unique Relevant Variables

- Manufacturing GDP
 - Manufacturing PMI – Survey by HSBC and Markit
 - Index of Industrial Production (IIP) from the Government of India
- Agricultural GDP
 - IIP Agriculture with a 1 quarter lag
 - IIP Fertilizer Production with a more significant lag
- Service Sector GDP
 - Services PMI
- Construction GDP
 - Credit to Commercial Real Estate with significant lags
 - Credit to Residential Real Estate with significant lag



Simultaneous Equations and its Success

Multiple GDP sectors are estimated concurrently in a SEM

- While GDP in the services sector depends on previous quarter's industrial production (among other indicators)...
- manufacturing GDP can be predicted using the previous value of the services sector GDP and construction GDP...
- and, agricultural GDP can be predicted by the fertilizer production from two quarters ago (among other indicators)...

Note the R-sq: the percentage of that sector GDP explained by the model. Around 50% or higher in such complex variables is considered high

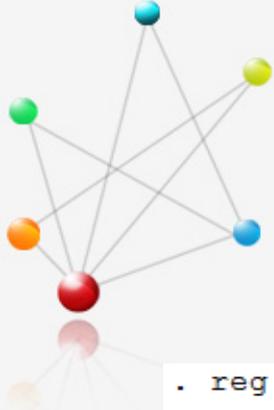
Two-stage least-squares regression

Equation	RMSE	<u>R-sq</u>	P
Agriculture	0.0197	<u>0.6261</u>	0.0002
Manufacturing	0.0230	<u>0.8519</u>	0
Construction	0.0219	<u>0.7501</u>	0
Service	0.0136	<u>0.4831</u>	0.0019



**We have a robust one quarter GDP forecast
We await policy decisions to refine the model**

Forecast For 2014-15: Q1	AgriGDP_growth 5.99%	Agricultural GDP Current 214165	Agricultural GDP Forecast 227003
Forecast For 2014-15: Q1	ManuGDP Growth 1.84%	Manufacturing GDP Current 286185	Manufacturing GDP Forecast 291451
Forecast For 2014-15: Q1	ConsGDP_growth 2.48%	Construction GDP Current 114652	Construction GDP Forecast 117496
Forecast For 2014-15: Q1	ServGDP_growth 6.68%	Services GDP Current 923377	Services GDP Forecast 985047
Forecast For 2014-15: Q1	Estimated Total GDP Growth Rate 5.37%	Total GDP Current 1538379	Total GDP Forecast 1620996



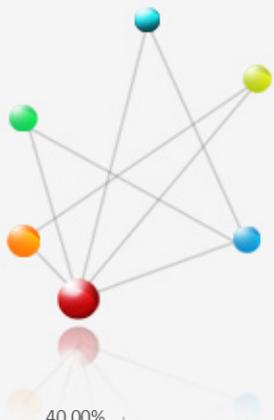
Previous quarter's GDP growth and previous quarter's change in FMCG sales explain 72% of change in FMCG sales in the current quarter

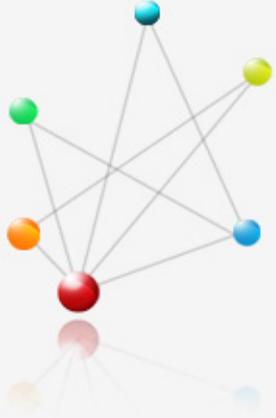
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. reg FMCGSalesGrowth L.FMCGSalesGrowth L.GDPGrowth
```

Source	SS	df	MS	Number of obs = 58		
Model	.247803316	2	.123901658	F(2, 55) =	74.36	
Residual	.091641089	55	.001666202	Prob > F =	0.0000	
Total	.339444405	57	.005955165	R-squared =	0.7300	
				Adj R-squared =	0.7202	
				Root MSE =	.04082	

FMCGSalesGrowth	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
FMCGSalesGrowth L1.	.6449216	.0786977	8.19	0.000	.4872079	.8026352
GDPGrowth L1.	1.133467	.2535391	4.47	0.000	.6253633	1.641571
_cons	-.0411007	.016941	-2.43	0.019	-.0750512	-.0071503

FMCG Demand and Lag1 GDP Growth – A single chart can show the relationship clearly





FMCG sales are expected to grow 3.81% (from same quarter last year) during 2014-2015 Q1

- And anywhere between 4.14% and 4.44% in 2014-2015 Q2
- Forecast two quarters of FMCG sales growth using 2013-2014 Q4 GDP data and robust ARIMA estimates - 3.81% and 4.14% respectively
- Forecast two quarters of FMCG sales growth using 2013-2014 Q4 GDP data and SEM estimates - 3.81% and 4.44% respectively