DETERMINANTS OF U.S. GDP

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Abstract

This paper examines the importance of various country-wide variables in explaining fluctuations in US GDP for the time period 1990-2005. We use single equation multivariate method to find out relevant explanatory variables. Real exports, real government expenditure, real rate of interest, lagged gross domestic product and lagged money stock are found to be significant in explaining fluctuations in US GDP. We have checked for serial correlation and heteroskedasticity and corrected for them. Model fits the data quite well and forecasts are most accurate for long time horizon.

Keywords: explanatory variables, multivariate method, single equation, US gross domestic product.

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Introduction

There has been a remarkable shift in perceptions of the U.S. economic outlook between the summer of 2000 and the beginning of 2001. The business cycle has returned with a vengeance when some believed that the 'new economy' based on the internet and other new technologies had abolished it permanently. There is little evidence of shifts since the early 1990's in past relationships governing the cyclical pattern in U.S. GDP. However, the nature of these relationships should be more widely appreciated, particularly as they now point to one of the sharpest downturns in the U.S. business cycle in the post-war period.

Economists usually see the United States as an engine of the world economy: U.S. and world outputs are closely correlated, and movements in U.S. economic growth appear to influence growth in other countries to a significant degree. A study by IMF in 2004, U.S. GDP accounted for over one-fifth of world GDP on purchasing power parity (PPP) basis and for nearly 30 percent of world nominal GDP at market exchange rates. The United States accounted for nearly a quarter of the expansion in world real GDP during the 1990s. World and U.S. growth have moved closely together in recent decades, with a correlation coefficient of over 80 percent.

U.S GDP growth has a substantial impact on the Indian economy as well. In India, the share of trade in GDP (including services trade) is now 45% of GDP, a far cry from the heyday of self sufficiency. The country is now integrated into the global economy as never before. Exports have been critical in pushing manufacturing growth into double digits The US is the destination for 15% of India's goods exports and around 70% of India's service exports. A sharp downturn in India's exports is likely to have spill-over effects on its domestic economy. US GDP and Indian IT revenue growth have shown significant correlation in previous years, and with the US economy showing signs of a possible slowdown, concerns about the implications on the Indian sector are on the rise. Additionally, Corporate profits will fall to single-digit growth overall, with several corporate going into the red. In such circumstances the stock markets will surely take a dive.

Literature Review

In Schneider and Spitzer (2004), a generalized dynamic factor model is utilized to produce short-term forecasts of real Austrian GDP. The forecasting performance of the model with a large data set of 143 variables has been assessed relative to simple uni-variate time-series forecasts. The variables can be attributed to the following categories:

• National account data: Real GDP and its components and deflators

• Prices: Consumer prices, producer prices, oil price, exchange rates

• Foreign trade: Real exports and imports

• Labor market: Unemployment, employment, vacancies

• Financial variables: Money aggregates, interest rates, stock prices, credits

• Miscellaneous: Industrial production

The main finding from the extensive out-of-sample forecasting experiment is that the factor model performs significantly better with a small data set of about five to eleven variables compared with the full data set of 143 variables.

Zestos and Tao (2002) investigate causal relations between the growth of GDP, exports, and imports for Canada and United States, using a tri-variate VEC model. The VEC models were estimated for the period 1948-1996 for Canada and United States. Granger causality tests were performed on the basis of the estimated VEC model. These tests reveal that the existence, direction, and degree of Granger causality in the two countries differ substantially. Stronger causality relations were revealed in the growth of GDP, exports, and imports for Canada than for the United States. The results for Canada show that three variables are closely related and the causality is established in every possible direction. For the United States, exports were found to cause GDP. Comparing the Canadian and U.S. Granger causality test, strong causality is supported for Canada, but not an equally strong relation is supported for United States.

The following is a list of economic indicators that the research uses for forecasting GDP:

Activity measure	*Possible indicators*
GDP	Lagged Dependent Variable
Consumption	Real Consumption.
Investment	Real Investment.
Residential investment	Residential Investment.
Government expenditure	Government Final Consumption Expenditure.
Exports of goods	Merchandise trade.
Imports of goods	Merchandise trade.
Money Stock.	M1,M3
Output gap	Unemployment rate.
CPI inflation	Inflation.

Williams et al (1976) has examined U.S. data to test whether there was evidence of unidirectional causality running from changes in nominal money stock to changes in nominal income, or vice versa. He has also examined the relationship between money and the real and price components of income separately. He found evidence of unidirectional causality running from money to nominal income, especially from money to real income. In Muellbauer and Nunziata (2001), a comprehensive one- year ahead forecasting model of U.S. GDP has been derived, examining collectively variables usually considered singly, example rate of interest, credit conditions, the stock market, oil prices & the yield gap all of which except the last are found to matter. The BOP, exchange rate & fiscal policy also play a role.

Econometric methodology

Multivariate models- also known as causal methods make projections of the future by modelling the relationship between a series and other series. There are, in the regression, both dependent variables and a set of independent variables (see Delurgio, 1998; Greene, 2008; Gujarati and Madsen, 1998; Gujarati 2003; Pindyck and Rubinfeld, 1998; Ramanathan 2002). We use

Classical Linear Single Equation Model

$$GDP = \beta_0 + \beta_1 X + \beta_2 G + \beta_3 R + \beta_4 REER + \beta_5 LAG\ M1 + \beta_6 LAG\ Y + \mu$$

where

GDP = REAL GROSS DOMESTIC PRODUCT OF U.S.A.(Quarterly, billions of $)

X = REAL EXPORTS (Quarterly, billions of $)

G = REAL GOVERNMENT EXPENDITURE (Quarterly, billions of $)

R = REAL RATE OF INTEREST (Proxied by 3-month treasury bill rate (%))

REER = REAL EFFECTIVE EXCHANGE RATE

LAG M1 = ONE PERIOD LAGGED M1

LAG Y = ONE PERIOD LAGGED GDP

Expected signs are as follows:

Real Exports: We expect a ***positive sign*** for the coefficients of real exports.

Real Government Expenditure: We expect a ***positive sign*** for its coefficient.

Real rate of Interest: We expect a ***negative sign*** for its coefficient.

Real Effective Exchange Rate: Is expected to have a ***positive*** effect on GDP.

LAG M1: Is expected to affect income ***positively***.

LAG Y: We expect a ***positive sign*** for the coefficient of Lag Y

Breusch-Godfrey Serial Correlation Lagrange multiplier test for serial correlation shows that there is significant coefficient for second order Serial Correlation also. Therefore, before making forecasts we have corrected for this in our single equation forecasting model by including AR(2) in our model. Thus we set the following model using method of least squares.

REALGDP = f (REALROI, REER, EXPORTS, GOVTEXP, LAGM1, LAG2Y ,AR(2))

Coefficients with the associated t-statistics is given below:

Dependent Variable: REALGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REALROI	-22.37785	11.97386	-1.868892	0.0686
REER	1.007472	2.023311	0.497932	0.6211
EXPORTS	1.830771	0.269453	6.794398	0.0000
GOVTEXP	0.718928	0.398651	1.803402	0.0785
LAGM1	0.416862	0.160504	2.597211	0.0129
LAG2Y	0.598659	0.076427	7.833061	0.0000
C	335.5878	384.2872	0.873273	0.3875
AR(2)	0.361006	0.153340	2.354278	0.0233
R-squared	0.998434	Mean dependent var		8537.194
Adjusted R-squared	0.998174	S.D. dependent var		1044.109
S.E. of regression	44.62177	Akaike info criterion		10.57997
Sum squared resid	83626.30	Schwarz criterion		10.88589
Log likelihood	-256.4992	F-statistic		3826.623
Durbin-Watson stat	1.052381	Prob(F-statistic)		0.000000
Inverted AR Roots	.60	-.60		

Table 1

DATA DEFINITION AND SOURCES

Variable Name	Data Definition	Frequency	Data Sources
GDP	Real Gross Domestic Product	Quarterly	www.economagic.com
Expnd	Private Consumption Expenditure	Quarterly	www.economagic.com
GDPI	Investment	Quarterly	www.economagic.com
G	Real Government Expenditure and Gross Investment	Quarterly	www.economagic.com
X	Real Exports	Quarterly	www.economagic.com
IM	Real Imports	Quarterly	www.economagic.com
REER	Real Effective Exchange Rate	Quarterly	www.economagic.com
M1	Nominal Money Stock	Quarterly	IFS
POP	Population	Monthly	www.economagic.com
Dcred	Domestic Credit	Quarterly	IFS
R	Nominal 3 Months T bill Rate	Monthly	www.economagic.com
Infln	Inflation	Monthly	www.economagic.com
LAG M1	Nominal Money Stock, lagged one period	Quarterly	IFS
LAG 2Y	Real GDP, lagged two period	Quarterly	www.economagic.com
M Diff	$M_t - M_{t-1}$	Quarterly	IFS
Y Diff	$Y_t - Y_{t-1}$	Quarterly	www.economagic.com

Table 2

White's Heteroskedasticity Test gives F-statistic to be 0.195202 which is less than the critical value. So we do not reject the null hypothesis of homoskedasticity.

The forecasting results are as follows. The following table gives forecasts of US GDP based on above model.

Forecast Period	One Quarter Ahead	Two Quarter Ahead	Three Quarter Ahead	Four Quarter Ahead
2003 Q1	10165.999			
2003 Q2	10146.793	10157.462		
2003 Q3	10265.410	10247.307	10271.693	
2003 Q4	10468.439	10429.680	10387.612	10401.774
2004 Q1	10687.036	10687.525	10601.186	10572.656
2004 Q2	10702.163	10738.062	10738.981	10689.505
2004 Q3	10724.475	10733.996	10807.795	10808.375
2004 Q4	10813.241	10812.306	10838.388	10884.136
2005 Q1	10910.977	10924.097	10922.287	10936.854
2005 Q2	10990.949	11001.734	11004.778	11003.740
2005 Q3	11044.023	11063.357	11082.199	11082.899
2005 Q4	11118.386	11123.366	11130.650	11156.794

Table 3

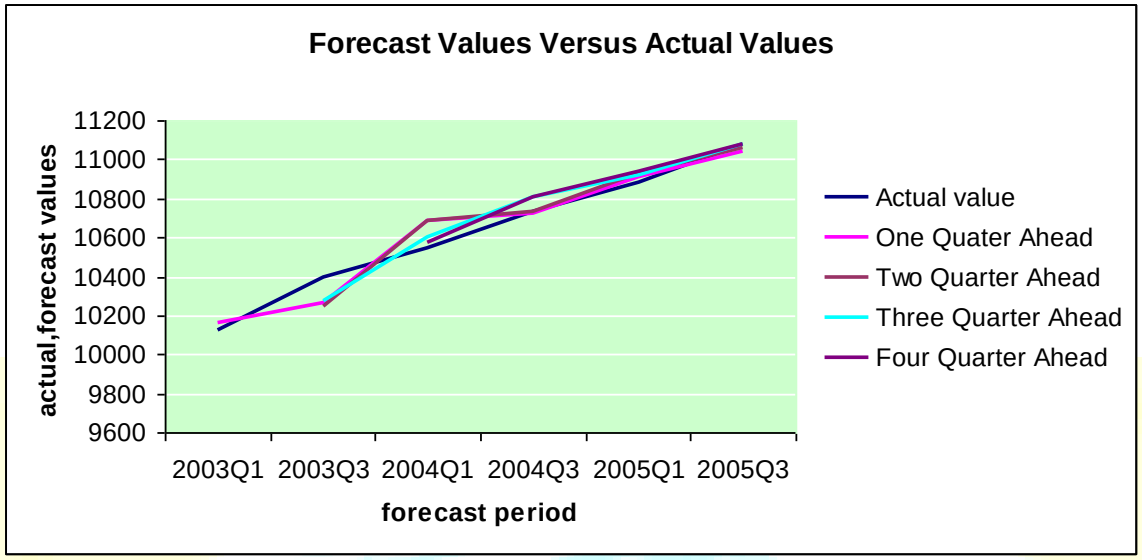

Figure 1

The precision of forecasts are summarized as follows:

DIAGNOSTICS	One Quarter Ahead	Two Quarter Ahead	Three Quarter Ahead	Four Quarter Ahead
ME	-9.716	-11.236	-20.297	-39.204
MAE	48.666	57.580	61.576	53.697
RMSE	66.249	76.208	70.607	**58.326**
MPE	-0.088	-0.098	-0.182	-0.360
MAPE	0.461	0.544	0.578	0.498
RMSPE	0.631	0.724	0.667	0.542
THEIL'S U2	0.686	0.402	0.261	**0.164**

Table 4

Inputs /Commands

A. Load the work file, click on File/New/Work file, this opens work file range window.

B. In the range window select quarterly and fill the data range as 1990.01 to 2005.04

C. Now to import the data click on Procs/Import/Read Text-Lotus-Excel and type in the file name. Type in the numbers of series in the file.

D. Click Quick/Estimate Equation. specify estimation period as 1990.01-2002.04 and the equation in the dialogue box i.e.

E. Click on forecast, select realgdp as the format of forecast, select static model, give a name to forecasted series and specify the forecasting range as 2003.01-2005.04 Keep changing the estimation and forecasting period to get recursive forecasts by including one quarter ahead actual value each time in estimation period.

F. Transfer forecasted values to excel sheet. Create tables of one quarter ahead, two quarter ahead, three quarter ahead and four quarter ahead forecasts.

G. Calculate measures of accuracy.

Conclusions

Real exports, real government expenditure, real rate of interest, lagged gross domestic product and lagged money stock are found to be significant in explaining fluctuations in US GDP. We have checked for serial correlation and heteroskedasticity and corrected for them. The forecasts based on our model are also quite precise.

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