International Research Journal of Management and Commerce
ISSN: (2348-9766)
Impact Factor 5.564 Volume 5, Issue 8, August 2018
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

THE EXTENDED TWO-GAP MODEL OF ECONOMIC GROWTH IN INDIA: VECTOR ERROR CORRECTION APPROACH

Dr. Kaushal Kumar
(Associate Professor, Department of Commerce, D.A.V. (P.G.) College, Dehradun)

Abstract

The paper empirically tests the applicability of the 2 gap model to the Indian economy by introducing an additional constraint i.e the "Human Capital Constraint" as human capital has been identified as the source of long run economic growth in endogenous growth models. The study analyses time series data over the period 1996-2018 using the vector error correction model to investigate the long-run and short-run relationship among the variables. The results indicate the presence of long run relationship of GDP with investment, exports, imports and human capital and bi-directional Granger causality between GDP and investment.

Introduction

India, with a population of over 1.2 billion, is one of the fastest growing economies in the world. It ranks 139th in per capita GDP (nominal) and 122nd in per capita GDP (PPP). Moreover, it is the world's 7th largest economy by nominal GDP and 3rd largest by PPP. India has been able to achieve a healthy growth rate averaging around 6% over the past few decades and this can be attributed to its demographic dividend, increasing integration with the global economy and healthy saving and investment rates. International Monetary Fund has estimated Indian growth to be around 7.1% in FY19, expecting it to grow to 7.3% in the current fiscal and to 7.5% in FY21. However, in recent years, India has witnessed a slowdown in the economy. Thus it can be said that India's growth is being held back by certain constraints that prevent it from realizing its full potential.

This paper tries to identify these constraints by extending the two-gap model framework which was contained in Post-Keynesian growth models for closed economies, as designed by Harrod and Domar. These models point out to the constraint which is binding for a particular economy's growth. Applying this extension to the Indian context, the constraints can be listed as follows:

1. **Savings Constraint**

   One of the major economic problems faced by any developing and underdeveloped country is inadequate savings i.e. inadequate domestic savings or inappropriate mobilization of savings for investment purposes. This gap between the required investment and the actual savings is called SAVINGS GAP.

2. **Foreign Exchange Constraint**

   A greater foreign exchange availability can be used by a less developed economy to break out of the small savings – small growth vicious circle. Moreover, it enables the country to acquire essential capital equipment that it is unable to produce indigenously. Thus, foreign exchange can be used to supplement savings, which are typically inadequate in less developed economies.

3. **Human Capital Constraint**

   Most of the studies have reviewed the above two gaps as suggested by the theoretical 2-gap model. Since, human capital is extremely crucial for a populous economy like India, we have tried to further explore this as a factor constraining growth. Even if the country has abundance of physical capital, it might not produce desired outcomes if there is lack of skilled labor to use that capital, thus, resulting in inefficiency in production.

One of the critiques of the 2 gap model is that it is not consistent with the neo-classical growth theory which assumes that there is an inherent substitutability of resources and the resources can thus be employed to different usage. For example, capital goods can be easily produced by idle domestic resources, this would eliminate the need for foreign exchange. However, the presence of rigidities and imperfections prevents this easy shifting of resources and thus the economy may not work according to the neo-classical theory.

The technique employed in the paper to analyze the above framework, is the Vector Error Correction Model. This method allows to jointly reveal the long run and short run relationships between variables**.** According to Ayadi et al., (2000), the VECM analysis is often employed in the evaluation of the performance of large macroeconomic models and is used to capture the linear interdependencies among multiple time series. Maddala (1992) noted that the VECM is the starting point when analysing the interrelationship among variables. According to Sims (1981), VAR/VECM technique is used in studies involving a description of data, forecasting, structural inference and policy analysis.

Therefore, the paper aims to establish whether or not the theoretical prescription of this extended version of the two gap model is applicable to the Indian context. Specifically, to see whether India can tap its own savings potential and to examine whether the resource inflow in the form of foreign capital can have a significant impact on economic growth for India, or whether the efficient use of available resources is being actually held back by inadequate human capital.

Literature Review

Empirical studies have been conducted for several countries to test the applicability of the two-gap hypothesis. A lot of these studies employ the tools of VAR and VECM analysis to examine the data and their relationship.

Kawthar Aghoutane & Mohamed Karim (2017) contribute to the empirical literature on the effectiveness of 2-gap model by studying the impact of Foreign aid in Morocco. They use the Vector Error Correction Model (VECM) to jointly capture the long-run relationship and short run dynamics between Official Development Assistance and economic growth and find a short term positive impact of foreign aid on growth while a negative impact in the long run.

Graham Jenkin(2014) employs VECM Forecasting and Granger Causality Analysis for Eight European Countries to find determinants of GDP by studying long run and short run causal relationships.

Michiko Yamashita & Anil Kumar Khachi apply vector autoregressive (VAR) analysis to nine developing countries, to which Japan has provided ODA over the past 30 years. The purpose of

this paper is to empirically test the two gap model and identify the factors that promote or restrain the economic growth in developing countries. The results of the empirical tests, however, do not give a straightforward answer to the effectiveness of the two-gap model as the growth-promoting (restraining) factors vary across the countries.

Akande, Emmanuel and Oluyomi Ola-David (2010) explore the relevance of the theoretical prescriptions of the Two-Gap model to the Nigerian economy from 1970-2007. The results of the autoregression analysis indicated that foreign aid does not give clear evidence of an imperative growth factor in Nigeria, FDI does but is volatile. The study found no theoretical or empirical justification for the assumption that filling a "trade gap" determined by "aid requirements" will boost trade and growth in the Nigerian economy.

Marcelo De Oliveira Passos and Rodrigo Da Rocha Gonclaves concluded that domestic savings turned out to be the binding constraint for financing of development of Brazil in the period 1960–2008 using a VAR three-gap models and a non-linear regression.

A lot of papers have also tried to study the impact of individual covariates on GDP.

1. Savings and Growth

Vaibhau et al (2008) found bi-directional causality between savings and economic growth in south-east and south Asia using two-stage least square method. Nazia Iqbal Hashmi and Ashish Kumar Sedai (2017) conducted an empirical study which confirms the existence of bi-directional granger causality between Domestic Savings and GDP in India. It also presents the results that out of all prime macroeconomic variables effecting growth, savings play a key role in the process. The studies largely suggest that domestic savings have a positive impact on growth.

2. Aid and Growth

Burnside and Dollar (1997), in their well-known paper "Aid, Policies, and Growth", find that aid has a positive impact on growth in developing countries which have good fiscal, monetary and trade policies but has little impact on countries where such policies are poor. Ann Veiderpass et al (2007), using panel data of sixty countries, found no clear pattern to explain the relationship between foreign aid and GDP. S. Lohani (2004), studied relationship between foreign aid and

development, using ordinary least square, the empirical results found that foreign aid have negative and significant impact on GDP.

The varying results obtained in different empirical studies point to the fact that there is ambiguity regarding the impact of foreign aid on a country's growth prospects.

3. Exports/Imports and Growth

Jaipal Singh and Laszlo Konya (2006) address the export/import led growth and growth driven export/import hypotheses for India using data from 1951-52 to 2003-04. The results show that exports and imports Granger cause GDP, both jointly and individually. Sani Hassan Hussaini (2015) uses time series data from 1980 to 2013 to test the Export Led Growth Hypothesis for India. The study found that within the period, the variables are cointegrated and there exists bidirectional relationship between GDP and Export.

4. FDI and Growth

Findlay (1978) and Wang and Bloomstrom (1992) examined the importance of FDI as a channel for transferring technology. They warned that in the absence of linkages, foreign investments could have limited effect in spurring growth in an economy. Borensztein *et al* (1998) shows that the country needs a certain level of human capital in order for the country to fully capture the benefits from FDI.

5. Human Capital- growth

Jandhyala Viswanath, K. L. N. Reddy and Vishwanath Pandi (2009) estimate the contribution of human capital and physical capital to economic growth using an aggregate production function approach. They use cross section data for 26 Indian states and union territories from 1995/6-1998/9 and find a strong positive relation between human capital and economic growth. Preeti Sharma and Priyanka Sahni (2015), in their paper, explore the causality relationship between the human capital investment (education & health investment) and economic growth of Indian economy using time series data running from 1991-92 to 2012-13. The study justifies that the components of human capital are the key variables which are affecting economic growth of India

and in the same way, economic growth is providing a platform for the growth of human capital.

Theoretical background

The two-gap model, developed initially by Chenery (1950) and formalized by Chenery and Bruno (1962), was based on the theoretical conclusions of the Harrod-Domar growth model. The model assumed that there is an excess supply of labor and that the growth is constrained only by the availability and productivity of capital. However, this model was based on a closed economy wherein foreign capital had no role to play and domestic savings to augment capital was the only source of growth. In order to introduce the role of foreign trade and exchange in the event of increased openness and a more integrated global economy, the Harrod-Domar model was modified and applied by McKinnon (1964), Chenery and Strout (1966), Findlay (1973), and others. They highlight how foreign capital plays an instrumental role in raising growth rate by facilitating availability of capital for production in case the domestic savings turn out to be inadequate for investment, keeping the capital-output ratio constant. The two gap model builds on the assumption that certain capital goods which can't be produced domestically need to be imported as they are essential for production of investment or some high technology goods. When export earnings or foreign capital inflows in the form of FDI and Foreign Aid fall short of the foreign exchange required to import capital goods which are needed for investment, the economy is said to be facing the foreign exchange constraint or the "**Foreign Exchange Gap**". In such a case, even an increase in domestic savings and investment will have a less than full impact. For instance, in 2011-12 and 2012-13, India did experience a foreign capital constraint with a large Current Account deficit of Balance of Payments of more than 4% of GDP. Due to inadequacy of foreign capital account surplus, India had to resort to utilizing the foreign exchange reserves held by RBI to plug in the gap.

On the other hand, if the economy is able to domestically produce investment goods without relying on foreign capital goods, then it might be able to create the desired impact on growth via domestic savings. However, in this scenario, if the economy is producing just enough for consumption and investment goods to sustain the current production level i.e it is not saving enough domestically, foreign aid might help cover the shortage by financing this deficit. If

through either channel, the economy is unable to generate desired level of savings or finances, the economy is said to be facing the Savings constraint or the "**Savings Gap**".

As can be seen in the literature, the two-gap model focuses solely on the availability of capital, relying on the assumption that a higher capital translates directly into a higher output, creating a one-for-one impact. Ishii (2001) argued that though the World Bank and other regional development banks had provided enough foreign capital to developing countries for filling the two gaps as calculated by the Harrod - Domar model, none of them were successful in attaining growth.

Thus, it suggests that the mere availability of capital might not guarantee a high output level unless the economy is equipped with the right skill set to properly utilize that capital to attain maximum productivity. The endogenous growth theory, discussed by Lucas (1990), Romer (1990) and others, asserts that knowledge or human capital accumulation is the driver of a sustained economic growth. The discussion of social capital advocated by Putnam (1993) also emphasizes how affecting the quality of human capital can raise labor productivity.

To account for this aspect, the paper extends the two gap model and talks about the third constraint, namely the "**Human Capital Gap**" faced by an economy. India was able to successfully identify the significance of human capital for development and growth. The Seventh Five Year Plan said, *'Human Resource improvement has essentially to be appointed a key part in any development technique, especially in a nation with such a grand population'.* Technology and innovation augmented by a highly skilled and productive labor force was the main driver of long term economic growth as predicted by the endogenous growth theory of Romer.

Methodology and Data

The paper at hand studies time series data using vector error correction analysis, in order to explain the Three-Gap Model explained above.

Time-series Data Analysis

Empirical analysis using time-series data requires each variable (say) x_t to be stationary. Stationarity requires a time series to satisfy the following properties:

1) its mean $E(x_t)$ and variance $V(x_t)$ are constant over time t, and

2) the autocovariance $Cov(x_t, x_{t-k})$ depends only on the distance between them i.e, lag *k* and not on the actual time *t* at which the covariance is computed.

Analysis using non stationary data leads to inaccurate results or the so called spurious regression problem (first mentioned in Granger – Newbold, 1974). The problem of spurious regressionis likely to arise, when two time-series exhibit both strong upward or downward trends. In this case the high R^2 could be due to the presence of the trend, and not due to any meaningful relationship between the two series. Thus the regression results would be inaccurate even though the model exhibits a high R^2 and significant t-values.

Unit root test

The first step of the analysis is the unit root test which is used to test for the non stationarity of the data.

Consider the autoregressive model $x_t = ax_{t-1} + u_t$, where u_t which has zero mean, constant variance, and is not autocorrelated, i.e u_t is white noise. If $a = 1$, then x_t is a non-stationary time-series known as a random walk, and we say that x_t has a unit root.

The model can further be modified as

$\Delta x_t = (a - 1) x_{t-1} + u_t = b x_{t-1} + u_t$, where $b = a - 1$.

The unit root is tested for x_t under the null hypothesis that $b = 0$.

If $\Delta x_t = x_t - x_{t-1}$ is stationary, where Δ is the first-difference operator, the original series x_t is integratedof order 1, and denoted by *I*(1). In general, if a time series has to be differenced *r* times before it becomes stationary, it is integrated of order *r*, or *I*(r).

The paper uses the **Augmented Dickey-Fuller** (ADF) test at 5% levels of significance to test for stationarity of the data series.

Lag Selection Criteria

The number of lagged terms is determined empirically by using the optimal lag selection criteria. The optimal lag length is selected if the majority of the selection criteria are in favour of a particular lag.

Johansen's cointegration test

If the economic series turns out be non-stationary at level and have the same integration order, then we need to test for the presence of cointegration or a long run relationship between the variables, which is given by the Johansen's cointegration test. The null hypothesis of no cointegration or long run relationship between variables in the model against the alternative hypothesis of presence of cointegration is tested. When the variables or series are co-integrated, then the linear combination of these series would be stationary and gives long run relationship between the variables.

The Cointegration procedure yields the likelihood ratio test statistic- Trace test (λ trace). The distribution of the test statistic follows chi-square distribution and gives the rank order of cointegration in the system.

Vector Error Correction Model

If a time-series system includes integrated variables of order 1 or greater and there is presence of cointegration among the variables, then we can't use the unrestricted VAR to analyse the data and the appropriate technique is the Vector Error Correction model (VECM), which can be viewed as a restricted VAR. Theoretically, the cointegration of two or more variables suggests the presence of a long-run relationship between them, and therefore even though the variables themselves are non-stationary, they will move closely together over time and their difference will be stationary. The system will converge to this long-run relationship in the equilibrium. A VECM captures this long-run information within an error correction mechanism that is used to model changes in the variables over time. The disturbance from the error correction mechanism can be interpreted as the distance by which the system is away from equilibrium at a point in

time. A VECM is also useful for determining short-run dynamics between variables by restricting long-run behaviour of variables.

In this paper, the VECM estimates are based on the theoretical framework of the three-gap model discussed earlier. We concentrate on the performance of the variable GDP. The three-gap model argues that the economic growth is limited by three restraining factors: the current account (foreign exchange) restraint, the domestic savings restraint and the human capital restraint.

Granger Causality

Consider the two-variable VAR model with *m* lags for simplicity:

$$y_t = \sum_{i=1}^{m} \lambda_i y_{t-i} + \sum_{i=1}^{m} \mu_i x_{t-i} + \gamma + u_t.$$

We say that a time series x_t Granger causes a time series y_t, if lagged y_t and lagged x_t explain current y_t. More specifically, if the null hypothesis $\mu_i = 0$ (for all i) is rejected, then x_t Granger causes y_t. Conversely, if we cannot reject the null hypothesis, then x_t does not Granger cause y_t.

In the context of VECM, presence of long-run causality does not necessarily imply presence of short-run causality and vice-versa. The Cointegration results only indicate the presence or absence of causality between the series of identified variables but it fails to reveal the direction of the causal relationship. Engle and Granger (1987) suggest that if cointegration exists between two variables in the long-run, then, there must be either uni- or bi-directional Granger-causality between these variables. Following Engle and Granger (1987), this paper employs a joint significance hypothesis F-test as a testing criterion of short-run causality. The null hypothesis states the estimated coefficients are jointly equal to zero.

We use the above tools for analyzing the quarterly time series data of India for the years 1996 to 2018 which was collected from World Development Indicators from the World Bank database, Hand Book of Statistics of India, the RBI data reports and the Trading Economics website. The study tries to analyse data related to the following variables: Real GDP (In Mn USD) (GDP), investment denoted by gross fixed capital formation (GFCF), Foreign aid (ODA), total exports

receipt (exports), total imports (Imports), Foreign Direct Investment (FDI), primary enrollment rates (Enroll) used as a proxy for human capital. The relationship would be specified as follows:

LGDPC= F (LGFCF, LAID, LEXP, LODA, LIMP, LFDI, LENROLL)

where L denotes the log operator

In the three gap framework, investments and imports and foreign aid constitute the "Savings Gap". Foreign Direct Investment, Foreign Aid and Exports account for the "Foreign Exchange Gap". Lastly, School Enrollment Rates represents the Human Capital Constraint.

RESULTS

Unit Root Tests

Variable	Level	First difference	Order of Integration
lnGDP	-1.305	-3.125	I(1)
lnGFCF	-1.195	-3.126	I(1)
lnFDI	-2.846	-5.085	I(1)
lnExports	-1.292	-3.761	I(1)
lnImports	-1.467	-3.910	I(1)
lnODA	-2.305	-3.928	I(1)
lnEnroll	-1.859	-3.095	I(1)

5% critical value (at level) = -3.055
5% critical value (at first difference) = -3.066

The above table presents the results of the unit root tests to check that the variables used in the VECM are stationary using augmented Dickey-Fuller Test with 1 period lag. All variables reject the null hypotheses of being the unit roots for their first differences with 5 percent significance. Thus, all variables are I(1).

Lag Selection Criteria

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	369.178			1.0e-11	-8.25405	-8.186	-8.08514	
1	1057.25	1376.1	36	0.000	3.8e-18*	-23.0739*	-22.5976*	-21.8916*
2	1085.64	56.783	36	0.015	4.6e-18	-22.901	-22.0164	-20.7052
3	1107.46	43.627	36	0.179	6.6e-18	-22.5786	-21.2856	-19.3693
4	1139.59	64.264*	36	0.003	7.6e-18	-22.4907	-20.7894	-18.2679

The model is regressed taking a one period lag as per the majority rule according to FPE, AIC, HQIC and SBIC.

Johansen Co-Integration Test

Maximum Rank	parms	LL	Eigenvalue	Trace statistic	5% critical value
0	42	1051.2677	.	119.9826	94.15
1	53	1079.9836	0.47172	62.5508*	68.52
2	62	1092.7571	0.24712	37.0038	47.21
3	69	1102.1859	0.18904	18.1461	29.68
4	74	1107.7908	0.11711	6.9364	15.41
5	77	1111.1372	0.07167	0.2436	3.76
6	78	1111.259	0.00270		

The Johansen Cointegration test gives the number of equilibrium relations existing between the variables known as the Rank Order of Cointegration. At Rank 0, the trace statistic is greater than the critical value hence we reject the null of no cointegration. At Rank 1, the null hypothesis of Cointegration of rank 1 is accepted.

Model Estimation

- **VECM Long Run Estimates**

As LGDP, LGFCF, LIMP, LEXP, LFDI, LAID and LENROLL are cointegrated of rank 1, thus the long-run relationship can be given as the following cointegration equation

$$EC_{t-1} = 1.00\Delta LGDP_{t-1} - 2.741LGFCF_{t-1} - 1.345LEXP_{t-1} + 1.789LIMP_{t-1} + 0.022LAID_{t-1} - 1.796LENROLL_{t-1} + 0.136FDI_{t-1} + 11.10$$

In the long term, GFCF, Exports and Enrollment Rate have a positive impact on GDP while Imports has a negative impact. All these coefficients are significant at 1% level. FDI and Aid are found to have an insignificant coefficient in the long run.

- **VECM Short Run Estimates**

	$\Delta LGDP_t$	$\Delta LGFCF_t$	$\Delta LEXP_t$	$\Delta LIMP_t$	$\Delta LAID_t$	$\Delta LENROLL_t$	$\Delta LFDI_t$
CointEq1	-.0042**	-.0558**	-.2393**	-.4394**	.0354	-.0142	-1.1717**
$\Delta LGDP_{t-1}$	.2586*	.4787*	1.8198*	3.1302**	2.2360	-.1851	5.8808
$\Delta LGFCF_{t-1}$	.0161*	-.2595*	-.0996	-1.0188**	-1.3018	.0668	-1.0155
$\Delta LEXP_{t-1}$	.0331	-.0181	.5291**	-.1135	.2190	-.0226	-.2644
$\Delta LIMP_{t-1}$	-.0239	.0584	.2702**	.1221	.0256	.0191	-.3574
$\Delta LAID_{t-1}$	.0003	.0199	-.0184	.0798	.0137	-.0036	.2462
$\Delta LENROLL_{t-1}$	-.0802	.2329	-.9433	-.0481	.0320	-.0798	-6.2559
$\Delta LFDI_{t-1}$	.0040	.0060	.0150	.0396**	-.0408	.0013	-.3275**
R-Square	0.7232	0.4868	0.4585	0.5105	0.0629	0.1218	0.2670

*Where ** denotes significance at 5% level*

*And * denotes significance at 10% level*

The estimation of the VECM gives a negative coefficient of the error correction term which is significant at 5% level which implies convergence to long run equilibrium. This coefficient suggests that the previous year's errors (or deviations from the long run equilibrium) are corrected for within the current year at a convergence speed of 0.424%.

The multivariate analysis reveals that GFCF has a positive and significant impact on GDP with one-period lag in the short run. It shows that a 1% increase in GFCF leads to an improvement of 0.016% in GDP. Further, we see that GDP also has a positive and significant impact on GFCF. Lagged GDP, Exports and Imports also significantly and positively impact Exports. FDI and GDP positively impact Imports at 5% level of significance and GFCF negatively affects Imports.

- **Granger Causality Test Results**

Granger causality tests for the joint significance of all the lagged values of a particular variable. Since the optimal lag for our model is 1, the results given by Granger causality are the same as those shown by the VECM short run estimates. Hence, we can conclude there is a bi-directional Granger causality between GDP and GFCF. Also, GDP uni-directionally Granger causes Exports and Imports.

In order to check for robustness, other proxies used for human capital were Mean Years of Schooling data for India and the Human Development Index reported by the World Bank. In either case, we obtained similar results as the ones obtained by using enrollment rates.

- **Model Diagnostics - Lagrange Multiplier and Jarque-Bera Normality Tests**

In order to validate the model, the residuals were tested for the presence of serial auto-correlation using the Lagrange multiplier (LM) method. We accept the null hypothesis at the 5% level of significance showing that there is no autocorrelation in the residuals. We also employed the Jarque-Bera (JB) test for normality in the residual and found that for GFCF, Imports, Exports and FDI we accept the null hypothesis of normally distributed residuals.

Discussion and Conclusion

Based on the results obtained, we see that there is a long run impact of GFCF, Imports, Exports and Enrollment on GDP. Therefore, in the long run, all the three constraints, namely, "Foreign Exchange Constraint", "Savings Constraint" and "Human Capital Constraint" are operative. However, only domestic investment (GFCF) has a significant impact in the short run. Thus, this highlights the importance of domestic savings constraint for the Indian economy in the short run. This suggests that promoting domestic investment in the short run might translate into higher growth rates but such an impact can be achieved in the long run when these efforts are supplemented by encouraging foreign capital inflows along with adequate investment in human capital.

The insignificance of most of the variables in their impact on GDP in the short run analysis might be due to the fact that the effect of a change in these variables is realized only after a delay period.

Moreover, despite human capital being pivotal for a large country like India, its insignificant short run impact can be attributed to the lack of a perfect measure of human capital for India, which might have distorted the results due to the use of imperfect proxies.

The results of this paper conform to the popular belief in the instrumental role of domestic savings to promote growth in a developing economy. Also, policies should be modified in order to enable the country to make the best possible use of incoming FDI and foreign aid (both showing insignificant impacts in our results) and channel them effectively to give an impetus to growth. Further, concerted efforts need to be made to enhance quality of human capital in the country so that a highly skilled population can utilize the existing capital more productively.