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Dynamics of Financial Globalization and Growth: Some Evidence from Emerging Market Economies

Harendra Kumar Behera and Rajiv Ranjan*

This paper empirically examines neoclassical prediction of financial globalization impact on growth in emerging market economies. Unlike other studies to use five year average to capture business cycles, the paper uses annual data for 27 countries for the period 1980 through 2007 to capture time series properties of the data. Using panel cointegration tests, the study found a long-run relationship between per capita income and financial globalization. The long-run coefficient of financial globalization impact on per capita GDP was estimated using panel FOLS and DOLS and found to be positive. The results remained unchanged controlling for trade openness.

JEL Classification : F36, C33, C22

Keywords : Financial Globalization, panel FMOLS, panel DOLS, panel cointegration.

Introduction

Finance does matter for economic growth and therefore opening up of the economy to receive financial flows by a resource scarce country. Capital account liberalisation has a number of benefits in terms of development of institutions, filling-up the resource gap and ultimately growth of the economy. On the other hand, the more financially integrated economy requires insurance to protect against the risks stemming from such financial openness. Many researchers have also found that opening up of a country is associated with likelihood of happening a crisis. Further, the way the current global financial crisis turned out has brought to the forefront the important role that finance play, reminding the costs and benefits associated with financial globalization.

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The phenomenon of large capital flows led by cross border trade of financial assets is not new to the emerging market economies (EMEs). The early wave of financial globalization traced back to a century old where the exchange rate system was fixed[1]. Integration was high in 1870–1914, declined sharply through the Great Depression and World War II, and subsequently recovered – gradually during the following two decades, and more rapidly beginning in the 1970s (Obstfeld and Taylor, 2004). The beginning of the twenty first century witnessed the level of integration that had experienced during 1870–1914. The new phase of financial globalization began with improvements in information technology and the removal of barriers to the free flow of capital across countries in the mid-1980s.

The recent episodes of capital flows to the EMEs have been debated because of their abrupt movement and resultant impact on asset prices and exchange rates, and ultimately the impact transmitted to the real sector of the economy. It is also argued by critics of financial globalization that international capital mobility may increase the probability of financial crisis (Reinhart and Reinhart, 2008). Financial globalization carries some degree of risk as evidenced from financial crisis in Asia and Russia in 1997-98, Brazil in 1999, Ecuador in 2000, Turkey and Argentina in 2001, and Uruguay in 2002. However, as Schmukler (2004) argued, crises were not just due to financial globalization. According to him, evidence suggests that crises are complex and have been a recurrent feature of financial markets for a long time, both in periods of economic integration and disintegration. The root cause of almost all the crisis could be attributed to the problem of information asymmetries rather than financial globalization itself. The net benefit of financial openness is large if it is managed well. The management is important because financial globalization is likely to deepen over time, led by its potential benefits. While the theoretical benefits of financial integration essentially presume a perfect market condition, the real world financial system operates through imperfect environment. It is, therefore, more important to know the costs and benefits associated with financial globalization. The large capital inflows (outflows) make the job of the policy makers of EMEs complex as they could deter also the expected benefits of financial globalization. Looking at the above issues, the time has come to examine whether capital account openness is beneficial for a country.

During the last few years, the EMEs experienced both large capital inflows and capital outflows[2]. Concomitantly, the emerging countries have also passed through phases of higher growth trajectory along with large reserve accumulation. The large reserve accumulations have helped these countries to sustain the adverse impact of the global crisis without having much damage. High growth in the EMEs also helped in taking strong policy decisions to further develop these economies. Besides, the EMEs, who had experienced larger capital flows in recent decades, were remained resilient during the crisis period. Although there are signs of positive effect of financial globalization on growth, empirical studies hard to find any such impacts. With this background, the paper is attempting to empirically examine the relationship between economic growth and financial globalization in EMEs. The following section provides the theoretical and empirical issues associated with the financial globalization and growth nexus. Section III of the paper traces the episodes of economic growth and the nature of capital flows to EMEs. A discussion about sources of data, different variables and methodology used in the study is presented in Section IV. Section V examines the empirical relationship between capital account openness and growth in EMEs and concluding observations are list out in final Section.

Section II
Theoretical and Empirical Issues in Financial Globalization

It is widely accepted in the theory that capital account liberalization has many positive effects, *viz.* capital account liberalization increases economic growth, encourages financial development and portfolio diversificaion. The neoclassical growth model suggests about a positive impact of capital account liberalization on growth through a more efficient international allocation of resources. Resources flow from capital-abundant developed countries, where the return to capital is low, to capital-scarce developing countries where the return to capital is high[3]. The flow of resources into the developing countries reduces their cost of capital, triggering a temporary increase in investment and growth that permanently raises their standard of living (Henry, 2007). Financial globalization can play an important role in encouraging development of institutions so that financial markets can effectively perform the crucial function of getting capital to its most productive uses which is key to generating growth and reducing poverty (Mishkin, 2005). The other view provided by some economists that removing one distortion – restrictions to capital movement – in the presence of other distortions that often exist in emerging markets- may not necessarily enhance welfare (e.g. Newbery and Stiglitz, 1989; Stiglitz, 2008). The later view gained relevance after occurrence of a couple of crises in the 1990s and the recent global financial crisis. Whereas the theory stands strong on positive growth impact of capital account liberalization, a number of cross-country literature on financial globalization hardly found any such positive impact on growth.

Though there is broad consensus about the relationship between financial globalization and economic growth, conflicts do exist while it is examined in practice. Financial globalization or capital flows and economic growth nexus has spurred volumes of empirical studies on both cross country and individual country cases. One of the earliest well known works by Rodrik (1998) shows that there is no evidence of positive impact of capital account liberalization on growth. On the contrary, another much cited paper by Quinn (1997) using IMF's Annual Report on Exchange Rate Arrangements to measure financial liberalization finds a positive relationship between the decline in restrictions to the capital account and growth. Thereafter many works based on Quinn's measure of financial globalization or with some refinement to that measure find mixed results while examining the relationship with growth.

The empirical literature on financial globalization and growth linkage is still to be corroborated as a little robust evidence exists in the context of the growth benefits of capital account liberalization. However, a number of recent papers in the finance literature report that equity market liberalizations do significantly boost growth. Thus, the empirical literature on overall impact of financial globalization is at best ambiguous. Surveying a large number of studies, Eichengreen (2001) concluded that the findings in literature are ambiguous on the evidence that liberalization has any impact on growth. In a comprehensive survey of research on financial globalization, *Kose, et al* (2006) reported that the majority of these studies, however, tend to find no effect or at best a mixed effect for developing countries. The apparent absence of robust evidence of a link between financial globalization and economic growth may not be surprising, in light of the well-known difficulties involved in finding robust determinants of economic growth in cross country or panel regressions. Critically examining the empirical studies on financial globalization, Henry (2007) strongly pointed out that the failure of existing studies to detect a positive impact of financial globalization on growth as the studies look for permanent growth effects whereas in the neoclassical growth model permanent decreases in the cost of capital and hence increase in the ratio of investment to GDP only have a temporary effect on growth. The model makes no predictions about the correlation between capital account openness and long-run growth rates across countries, and certainly does not suggest the causal link needed to justify cross-sectional regressions. What the neoclassical model predicts is that liberalizing the capital account of a capital-poor country will temporarily increase the growth rate of its GDP per capita and thus, permanently increase the level of GDP per capita.

Neoclassical growth models with well defined steady states expect a long-run relationship between the levels of output and investment. Further, the model including only the growth rate of GDP excludes the neoclassical growth models by assumption, instead of including these models in conjunction with endogenous growth models (Hansen and Rand, 2005). Therefore, we have considered level of per capita GDP and financial globalization (net capital flows to GDP ratio) in our empirical model instead of GDP growth. As reported by Behera (2008), this relationship is parallel with the relationship between GDP (or GDP per capita) and domestic investment[4]. It may also be possible that economies do not converge to steady states (e.g.

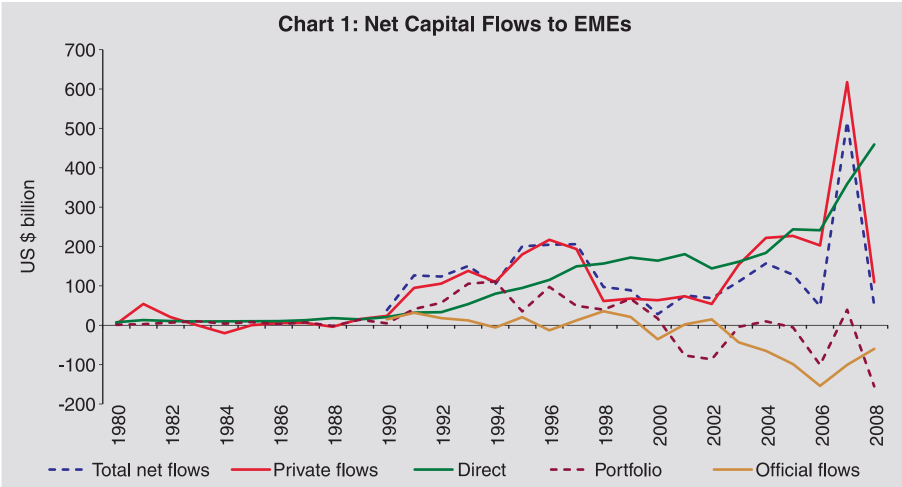
AK-type models of growth) or foreign investment has an impact on total productivity so that a rise in the financial globalization leads to permanent movements in the steady states.

Since earlier studies considered growth rates of GDP or per capita GDP to study the relationship between financial globalization and economic growth failed to examine the timeseries property of the data in levels. Using GDP per capita instead of growth rate of the same, we have advantage of studying both the long-run and short-run relationship along with cross-sectional impact in our study. Along with large cross-sections, long-timeseries data have the benefit of examining the dynamic link between financial openness and economic growth by using recently developed panel techniques, *viz.* panel cointegration tests, and fully modified OLS (FMOLS) and dynamic OLS (DOLS) techniques.

Section III
Stylized Facts of Capital Flows and Growth in EMEs

With the increase in total net capital inflows to the EMEs, the net private capital flows have become dominant during the 1990s and 2000s (Figure 1)[5]. Direct investment component of private capital inflows continued to remain large and stable over the years despite the crises in different phases reflecting the long-term interest of the investors in EMEs. In the 1970s and 1980s, private capital flows to EMEs were concentrated in Latin America. During the last one and half decades, the emerging Asia and emerging Europe became important destinations for private financial flows.

In the early 1980s, with sharp decline in commodity prices, international interest rates rose to unprecedented levels, and economic activity in industrialized countries slumped. This pushed many EMEs into financial difficulties. Starting with Mexico in August 1982, a number of Latin American nations announced moratoriums on their sovereign obligations. As a result of the above, the net private capital inflows to EMEs turned negative in 1984. However, introduction of several lending plans by the International Monetary Fund (IMF) and



development banks, led to increase both official and bank loan flows to EMEs during the 1980s. The Brady Plan of 1989 allowed countries experiencing debt crises to restructure their debt by converting existing bank loans into collateralised bonds at a significant discount or at below market interest rates. Financial flows to EMEs resumed quickly following the Brady exchanges in the early 1990s. A notable feature of this period was the surge in the flow of capital to EMEs in Asia, notwithstanding the high domestic savings rates (Perrault, 2002).

As against official capital dominated regime, the 1990s saw a shift to non-debt-creating forms of capital inflows, and direct investment became the principal source of new capital available to EMEs. Importantly, direct investment has remained strong even in the aftermath of the crises in EMEs during 1997-1998. In contrast, the EMEs started exporting other types of capital flows, particularly interbank lending and portfolio flows.

During the 2000s, the emerging Asia and emerging Europe are the dominants in receiving the largest amount of private capital flows (Table 1). Furthermore, among the emerging countries, some countries tend to receive large amounts of inflows while other countries receive little foreign capital. As a consequence, the share of flows dedicated to relatively low- and middle-income emerging

Table 1: Net Private Capital Flows to EMEs by Region (US $ billion)

Item	2003	2004	2005	2006	2007	2008	2009f
1	2	3	4	5	6	7	8
Private Capital Flows to EMEs	225.1	318.5	521..0	564.9	887.8	392.2	140.5
Latin America	30.7	29.0	72.3	51.5	173.7	88.5	62.6
Emerging Europe	66.2	113.7	204.3	226.3	382.6	213.9	-32.8
Africa/Middle East	5.2	10.3	26.1	28.3	35.6	31.0	23.0
Emerging Asia	123.0*	165.5*	218.3	258.9	295.9	58.8	87.7

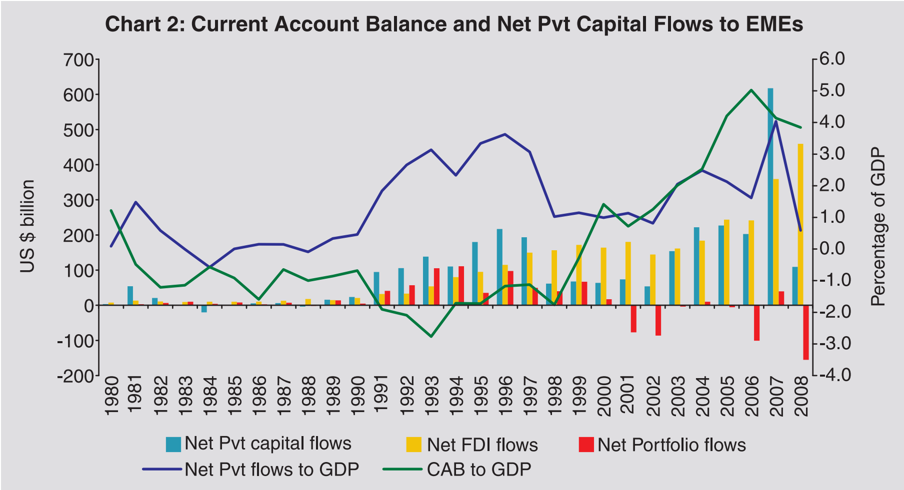
f = forecasted; *: includes pacific region also.

Note : Data are collected from various issues of IIF Report on 'Capital Flows to Emerging Market Economies' and therefore, the actual revised data for 2003-2006 may be different from what is reported here.

Source : Institute of International Finance.

countries has decreased over time. This pattern is important to be noted because if countries benefit from foreign capital, only a small group of countries are the ones benefiting the most. The unequal distribution of capital flows is consistent with the fact that the income among developing countries is diverging although the causality is difficult to determine (Schmukler, 2004).

Another notable feature of emerging market economies is that the current account balance became positive since 2000 as against net deficits during the 1980s and 1990s (Figure 2). Furthermore, net



private capital flows remained buoyant during mid-1990s and 2000s maintaining a high growth momentum. The net inflow came down significantly in 2008, especially in the later half of the year, reflecting risk aversion of the investors due to global crisis that started with the US sub-prime debacle in August 2007.

With the increase in capital flows, particularly private capital flows, the growth of EMEs has increased substantially signaling about the positive relationship between financial openness and economic growth. As can be observed from Figure 3, GDP growth rates were high during mid-1990s and in the current 21st century when the capital flows to EMEs were significantly large. However, both the capital inflows and growth were lower in 2008 mainly due to global economic and financial crisis.

Though it is true that GDP growth remained high during the phases of heavy capital flows, it is not clear whether capital inflows increased growth in EMEs. Findings of many studies show that capital inflows used to be high during the phases of high economic growth and they are pro-cyclical in nature. It has been justified that capital account liberalization by fulfilling the investment demand in capital poor countries enhances economic benefits. However, a converse can be observed from Figure 4 that EMEs have higher saving rates than investment rates during 2000s.

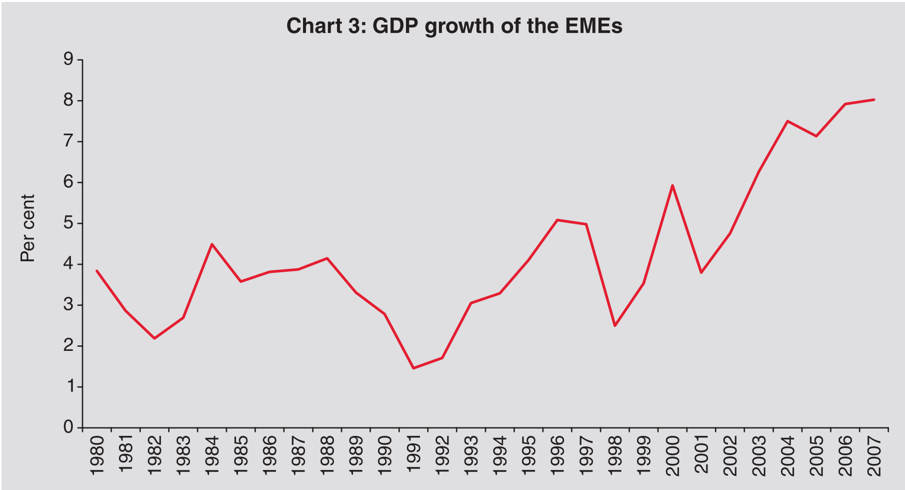
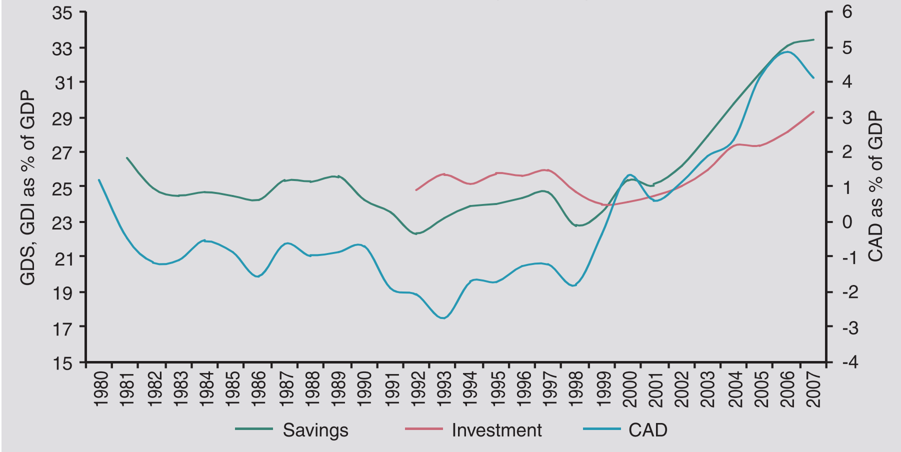
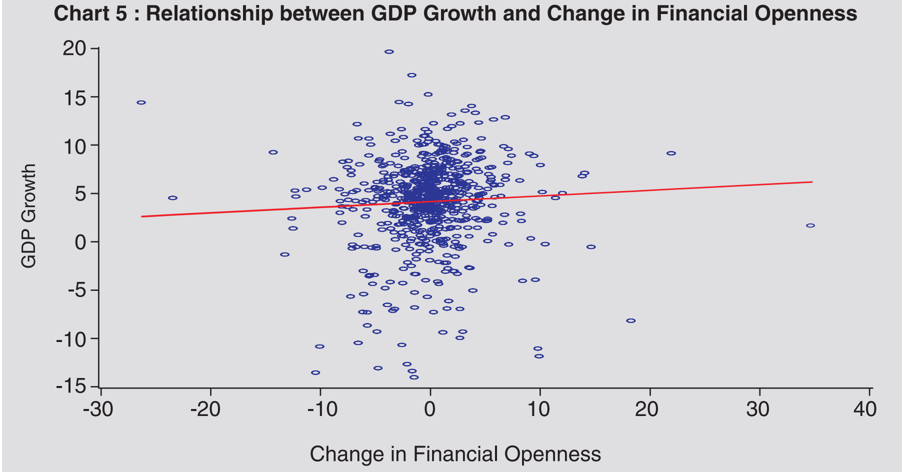


Chart 4: Domestic and foreign Savings of EMEs



The same can be confirmed from the positive current account balance reflecting net exporter of capital. Therefore, the immediate question is whether the EMEs need capital inflows at all and if they require, how effective is capital flows for them in achieving their goals. As mentioned above, it may be possible that higher growth in the EMEs attracting capital flows. However, as can be observed from a scattered regression plot for select 27 emerging countries given in Figure 5 that there is a positive relationship between per capita GDP growth and financial openness[6]. It may be possible that productivity growth led by financial

Chart 5 : Relationship between GDP Growth and Change in Financial Openness



globalization has been impacting GDP growth. Thus, it is relevant to study the relationship between capital flows and economic growth in EMEs. To examine this issue we tried to study the long-run linkages of financial openness and per capita GDP.

Section IV
Data and Methodology

Financial Globalization or financial openness (*FINOP*) in this study is measured as the net capital flows to GDP ratio[7]. The net flows are net of financial account excluding official reserves, *i.e.* the credit less debit of financial account of balance of payments of the emerging market countries. The choice of the data period for the empirical analysis is based on the availability of data on net capital flows, *i.e.* for the period 1980 through 2007. Per capital GDP (*PGDP*) used in the study is calculated taking real *PDGP* growth rates and GDP for 1980 dividing total population in that year. Other variable used in the paper is trade openness (*TROP*) measured as the sum of merchandised exports and imports as a share of GDP. Net capital flow, exports and imports data are collected from Balance of Payment Statistics of IMF CD-ROM and the GDP, per capita GDP growth rates, population data are taken from World Bank online database. The choice of countries in the EMEs is based on the MSCI classification of emerging market economies plus Saudi Arabia. The data used in the study are for 27 countries[8] for the period 1980-2007 resulting total 756 observations. L is pre-added when the variables are in natural log forms, e.g. *LPGDP* for log of *PGDP*.

Methodology

Model:

We have used standard neo-classical growth model where the output per capita (*Y*) is a function of capital per labour (*K*) in Cobb-Douglas form:

$$Y = A_0 e^g K^\alpha \tag{1}$$

where A_0 is the initial stock of knowledge. In a standard Solow model, total factor productivity (*TFP*) is autonomous, in the long-run, steady state growth equals *g*. The alternative specifications, where *TFP* is assumed to dependent on *FINOP* i.e., g = g(*FINOP*) in a linear form, as follows.

$$Y_t = \left\lfloor A_0 e^{(g_1 + g_2 FINOP_t)} \right\rfloor K_t^{\alpha} \tag{2}$$

Taking log in both sides:

$$y_t = \gamma + g_1 + g_2 FINOP_t + \alpha k_t \tag{3}$$

where $\gamma = \ln(A_0)$; and y_t and k_t are logarithm of Y_t and K_t.

In the equation (3) output per capita increases with the increase in financial globalization and increase in capital-labour ratio over time.

We have estimated a simplified version of equation (3) and considered the panel method with cross section (*i=1,2 …27*) and time period (*t=1,2 …28*) dimension:

$$y_{it} = \gamma_i + g_1 + g_2 FINOP_t + \varepsilon_i \tag{4}$$

Econometric Framework[9]:

Like timeseries data, the panel data with longer time dimension needs to qualify for the stationarity tests. The recently developed panel-based unit root tests by Levin, Lin and Chu (2002), Breitung (2002), Maddala and Wu (1999), Hadri (1999), and Im, Pesaran and Shin (2003) are similar to tests carried out on a single series. Interestingly, these investigators have shown that panel unit root tests are more powerful (less likely to commit a Type II error) than unit root tests applied to individual series because the information in the time series is enhanced by that contained in the cross-section data. We have applied all the above mentioned unit root tests to examine the stationarity of the panel data used in the study.

Recently developed panel cointegration techniques, *viz.* Pedroni cointegration test (1999 and 2004), Kao cointegration test (1999) and

Maddala and Wu cointegration test (1999) were applied to test the long-run relationship between variables in above equation (4).

Section V
Empirical Analysis:

To test the stationarity of the variables, the panel unit root tests conducted in level as well as with first difference and the results are reported in Table 2. The results show that the variables LPGDP and TROP are I(1) in levels and I(0) in first differences. LPGDP is non-stationary at level as both LLC and IPS tests could not reject the null hypothesis of having a unit root and Hadri test rejects the null of not having a unit root. In case of trade openness (TROP), LLC, Breitung, IPS and MW statistics confirmed that the null of having a unit root could not be rejected; and null of no unit root in the data were rejected as the Hadri Z statistics rejects the null hypothesis. In contrast, except Hadri test, all the tests show that FINOP is stationary at level. However, all the variables are stationary at the first difference.

Table 2: Results of Panel Unit Root Tests

	Level				
Variables	**LLC**	**Breit**	**IPS**	**MW**	**HD**
LPGDP	2.73	-2.36*	8.06	24.12	16.36*
FINOP	-2.08*	-5.32*	-4.85*	130.83*	5.18*
TROP	4.09	0.79	3.69	34.54	13.53*
First Difference					
	LLC	**Breit**	**IPS**	**MW**	**HD**
LPGDP	-11.23*	-7.90*	-11.80*	234.84*	5.02
FINOP	-21.30*	-12.24*	-23.38*	486.56*	1.96
TROP	-14.58*	-8.51*	-15.64*	322.09*	3.99

*: indicates significant at 5 per cent level for rejecting the null hypothesis of nonstationarity (LLC, Breitung, IPS) or stationarity (Hadri).

Note : (1) LLC: Levin, Lin & Chu; Breit: Breitung; IPS: Im, Pesaran and Shin; MW: Maddala and Wu; HD: Hadri.

(2) The statistics are asymptotically distributed as standard normal with a left hand side rejection area, except on the Hadri test, which is right sided.

(3) Lags for conducting unit roots are selected through Schwarz criteria.

To confirm the order of integration of the variable FINOP, we have also conducted intermediate ADF unit root tests for each cross-section as can be generated from IPS tests. The test results are presented in Table 3. The results witnessing unit roots in several country cases and average t-statistics is insignificant indicating to have a unit root in FINOP in level. Therefore, we assume that FINOP is an I(1) process. Thus, the evidence suggests that the variables in question do evolve as non-stationary processes and the application of OLS (or GLS) to the equation (4) will result in biased and inconsistent estimates. Therefore, it is necessary to turn to panel cointegration techniques to examine the existence of a long-run equilibrium relationship among the non-stationary variables in level form.

We proceed to check for cointegration between the variables in equations (4), and also including another variable trade openness (TROP) in that equation through the tests proposed by Pedroni (1999 & 2004), Kao (1999) and Maddala and Wu (1999). Pedroni cointegration tests have four panel statistics and three group panel statistics. In the case of Pedroni's panel statistics, the first-order autoregressive term is assumed to be the same across all the cross sections (within cross sections), while in the case of group panel statistics the parameter is allowed to vary over the cross sections (between cross sections). On the contrary, Kao's test assumes homogeneous cointegrating vectors and autoregressive coefficients. The results of Pedroni and Kao cointegration tests are reported in Table 4. The results in Table 4 show that the null of no cointegration is rejected as all test statistics are significant. All the four panel test and three group test – statistics are significant suggesting that there is a cointegrating relationship between per capita GDP and financial openness both in within the cross-section and between cross-sections. When trade openness included in the equation, the result remained unchanged. Similarly, the ADF t-statistic from Kao's cointegration test shows that there is a long-run relationship between per capita GDP and financial liberalization with the rejection of null of no cointegration. Inclusion of trade openness, in fact, increases the

Table 3: Results of ADF Tests for FINOP

Cross-sections	t-Stat	Prob.	Lag	Obs
Argentina	-2.73**	0.08	0	27
Brazil	-3.59*	0.02	6	21
Chile	-1.89	0.33	1	26
China	-2.82**	0.07	0	25
Colombia	-2.90**	0.06	3	24
Czech Republic	-2.49	0.14	0	14
Egypt	-3.59*	0.01	0	27
Hungary	-0.61	0.85	4	21
India	1.86	1.00	2	25
Indonesia	-1.78	0.38	0	26
Iran	-4.27*	0.00	0	27
Israel	-1.52	0.51	1	26
Jordan	-3.28*	0.03	0	27
Korea	-4.31*	0.00	6	21
Malaysia	-1.80	0.37	0	27
Mexico	-2.61**	0.10	0	27
Morocco	-2.93**	0.06	0	27
Pakistan	-2.22	0.20	1	26
Peru	-3.26*	0.03	0	27
Philippines	-2.62**	0.10	0	27
Poland	-3.98*	0.01	0	27
Russian Federation	-2.47	0.14	0	15
Saudi Arabia	-1.20	0.66	1	26
South Africa	-0.83	0.79	4	18
Thailand	-2.39	0.16	1	26
Tunisia	-4.03*	0.01	3	24
Turkey	0.66	0.99	2	25
Average	**-2.36**	**0.26**		

*: indicates significant at 5 per cent level for rejecting the null hypothesis of nonstationarity.

significance of t-values indicating a relationship among per capita GDP, financial openness and trade openness.

The study also employed a Johansen cointegration test using the methodology proposed by Maddala and Wu (1999). Using Fisher-type test, Maddala and Wu proposed an alternative approach to test cointegration in panel data by combining tests from individual

Table 4: Panel Cointegration Test Results

	Relationship between LPGDP & FINOP	Relationship between LPGDP, FINOP& TROP
Pedroni Test Statistics		
Panel ν-Statistic	6.22* (0.00)	-3.02* (0.00)
Panel ρ-Statistic	5.40* (0.00)	4.67* (0.00)
Panel t –Statistic (non-parametric)	2.08* (0.05)	2.58* (0.01)
Panel t-Statistic (parametric)	9.23* (0.00)	5.23* (0.00)
Group ρ-Statistic	6.39* (0.00)	6.22* (0.00)
Group t-Statistic (non-parametric)	2.56* (0.02)	2.65* (0.01)
Group t-Statistic (parametric)	8.92* (0.00)	8.63* (0.00)
Kao's ADF Test Statistics	1.28** (0.10)	-1.74* (0.04)

*: Significant at 5 per cent level; **: Significant at 10 per cent level
Figures in parentheses are p-values.

cross-sections to obtain at test statistic for the full panel. The result of Madala and Wu cointegration test using an underlying Johansen methodology are provided in Table 5. The results corroborated our earlier findings by confirming at least one cointegrating vector exists between the PGDP and FINOP as both the trace and maximum-eigen test statistics are significant at 1 per cent level.

Panel DOLS and FMOLS Estimates

Having established that there is a cointegrating relationship exists between the variables, the long-run estimates of the equation (4) can be obtained using fully modified ordinary least square (FMOLS) and dynamic ordinary least square (DOLS). In order to estimate long run coefficients of the cointegration relationship (g_2), we use FMOLS and

Table 5: Panel MW- Johansen Cointegration Test Results

Null	Alternative	λ_{trace}	λ_{max}
r = 0	r ≥ 1	133.80* (0.00)	115.00* (0.00)
r = 1	r ≥ 2	63.56 (0.18)	63.56 (0.18)

*: indicates significant at 1 per cent level.
Figures in brackets are probability values computed using asymptotic Chi-square distribution.

DOLS between-dimension approach proposed by Pedroni (2001) as the conventional OLS estimator is a biased and inconsistent estimator when applied to cointegrated variables[10]. The FMOLS estimator not only generates consistent estimates of the β (g_2 in our study) parameters in small sample (in our case 27 years), but it controls for the likely endogeneity of the regressors and serial correlation. Further, an important advantage of the between-dimension estimators is that the form in which the data are pooled allows for greater flexibility in the presence of heterogeneous cointegrating vectors.

The results of DOLS and FMOLS regression estimates for individual countries are reported in Table 6 and 7. The estimation is also conducted to capture common shocks through common time dummies[11]. As can be observed from the Table 6, FMOLS and DOLS estimates are significant for most of the countries. Further, the coefficients of the FINOP are significantly positive for many countries and significantly negative for only few countries. With capturing common shocks to the countries, the results remained almost indifferent.

Table 7 provides slope coefficients of FINOP controlling for trade openness (TROP). It is interesting to observe that the coefficients of FINOP for many countries turned positive. Further, the significance level of few countries, which were earlier less, has increased now. The coefficients of TROP are positively significant for most of the countries.

The results for panel Group-Mean DOLS and FMOLS with and without common time dummies are reported in Table 8. Further, the results are also reported in Panel B controlling for trade openness. In all the cases, the cointegrating coefficient, *i.e.* the coefficient of the FINOP is significantly different from zero. The coefficients of TROP are also significantly positive as expected in the theory that trade openness has positive impact on growth. In Panel A, the coefficient of FINOP is significant and positive both including common time dummies and without including common time dummies. Further, magnitude of the coefficients though varied with dummies and without dummies, it remained more stable in case of FMOLS. The results in

Table 6: Results of Panel DOLS and FMOLS Estimates

(Dependent Variable: LPGDP, Independent Variable: FINOP)

	Without Time Dummies				With Common Time Dummies			
Country	**DOLS**		**FMOLS**		**DOLS**		**FMOLS**	
	FINOP	**t-statistic**	**FINOP**	**t-statistic**	**FINOP**	**t-statistic**	**FINOP**	**t-statistic**
Argentina	0.27	-1.77**	0.32	-2.06**	1.17	0.34	0.75	-0.80
Brazil	-0.47	-3.52*	-0.43	-4.12*	-0.77	-3.34*	-0.52	-3.35*
Chile	-3.94	-7.52*	-2.92	-6.85*	-3.33	-7.49*	-1.55	-5.39*
China	5.99	0.93	5.33	1.17	8.08	3.06**	6.31	2.67**
Colombia	0.28	-0.82	0.30	-1.03	-1.22	-5.81*	-0.86	-5.65*
Czech Republic	-1.40	-2.70*	-0.87	-3.96*	-0.08	-13.04*	-0.02	-16.05*
Egypt	-1.31	-3.90*	-0.74	-4.08*	-0.11	-6.38*	-0.18	-10.26*
Hungary	1.23	0.40	0.74	-0.68	-0.05	-3.65*	-0.06	-5.44*
India	17.90	5.73*	7.38	4.05*	2.33	2.37**	2.16	2.61**
Indonesia	-2.41	-4.27*	-2.36	-4.76*	-1.59	-4.64*	-1.34	-4.90*
Iran	-0.68	-2.23**	-0.52	-2.69*	-0.46	-3.71*	-0.33	-4.09*
Israel	-0.98	-3.96*	-1.02	-5.50*	0.24	-4.41*	0.21	-4.97*
Jordan	-0.48	-7.99*	-0.22	-8.95*	-0.39	-3.49*	-0.29	-5.54*
Korea	0.34	-0.32	-0.98	-1.10	1.99	0.77	0.73	-0.20
Malaysia	-1.16	-4.76*	-1.06	-5.59*	-0.57	-4.39*	-0.49	-5.56*
Mexico	0.24	-1.26	0.06	-2.37**	-0.56	-3.33*	0.06	-2.40**
Morocco	-1.39	-4.17*	-1.21	-4.62*	0.04	-5.35*	0.01	-7.74*
Pakistan	-1.39	-2.44**	-0.39	-1.60	1.23	0.31	0.21	-2.38*
Peru	-0.66	-3.14*	-0.50	-3.47*	0.89	-0.10	0.03	-1.59
Philippines	-0.34	-4.17*	-0.29	-4.36*	0.10	-2.00**	0.27	-1.85**
Poland	3.20	2.58*	1.97	1.47	1.17	1.39	0.98	-0.17
Russia	1.31	0.30	0.80	-0.32	1.24	0.64	0.47	-1.49
Saudi Arabia	-0.10	-19.86*	-0.12	-9.92*	0.30	-6.02*	0.23	-3.74*
South Africa	0.53	-1.44	0.48	-2.01**	-1.28	-8.46*	-1.23	-7.67*
Thailand	-1.11	-2.94*	-0.88	-2.81*	-0.46	-2.33*	-0.28	-2.40*
Tunisia	-0.10	-0.61	-0.29	-1.09	1.22	0.74	0.83	-0.66
Turkey	2.53	1.17	2.41	1.97**	-0.09	-3.32*	0.08	-4.00*

*, **: Significant at 5% and 10% level, respectively.

Panel B are different from that in Panel A. Without time dummies, the DOLS estimates of FINOP coefficient is positive while FMOLS estimates of the FINOP coefficient is negative. Capturing the impact of common shocks to the countries in the panel through common dummies, the DOLS coefficient of FINOP remained unchanged but significant level has increased. The FMOLS coefficient of FINOP turned positive and significant level is also higher than that in the

Table 7: Results of Panel DOLS and FMOLS Estimates

(Dependent Variable: LPGDP, Independent Variable: FINOP and TROP)

	Without Time Dummies								With Common Time Dummies							
	DOLS				FMOLS				DOLS				FMOLS			
Country	FINOP	t-stat	TROP	t-stat	FINOP	t-stat	TROP	t-stat	FINOP	t-stat	TROP	t-stat	FINOP	t-stat	TROP	t-stat
Argentina	1.63	3.85**	0.59	-8.41*	1.11	0.58	0.52	-6.50*	1.85	1.58	0.29	-2.51*	0.90	-0.30	0.13	-3.60*
Brazil	-0.77	-4.60*	0.24	-5.20*	-0.61	-4.54*	0.22	-4.73*	-0.32	-6.48*	0.43	-13.47*	-0.28	-5.76*	0.42	-10.68*
Chile	-6.34	-4.19*	-0.90	-2.57*	-1.53	-3.02*	0.73	-0.67	-2.22	-7.88*	-0.70	-11.03*	-1.32	-5.82*	-0.58	-6.34*
China	0.80	-0.11	1.83	3.59*	-0.02	-0.77	1.72	4.35*	5.47	1.87	2.22	1.27	3.40	1.13	1.80	0.98
Colombia	0.98	-0.07	1.09	0.79	0.79	-0.89	1.11	1.05	-0.23	-4.29*	0.46	-6.39*	-0.15	-4.42*	0.39	-7.22*
Czech Republic	-0.72	-22.96*	0.28	-120.38*	-0.20	-8.90*	0.28	-27.90*	-0.18	-137.30*	0.05	-432.57*	-0.02	-21.53*	0.04	-62.74*
Egypt	0.86	-0.08	-0.08	-3.41*	-0.81	-4.10*	0.20	-4.39*	-0.23	-7.50*	-0.12	-39.67*	-0.08	-14.36*	-0.14	-41.83*
Hungary	-0.10	-3.10*	0.29	-19.70*	0.02	-4.35*	0.26	-18.41*	-0.58	-10.16*	0.21	-24.96*	-0.32	-7.23*	0.15	-17.31*
India	2.13	0.39	2.04	4.11*	-0.73	-1.81**	2.05	4.85*	0.43	-0.94	-1.03	-7.47*	0.92	-0.17	-0.82	-7.04*
Indonesia	2.43	0.81	1.51	1.03	-0.93	-1.58	0.49	-1.48	-2.14	-6.52*	-0.34	-9.43*	-1.63	-5.70*	-0.25	-9.95*
Iran	-1.52	-4.10*	0.61	-2.15**	-0.86	-3.99*	0.52	-3.02*	-0.52	-3.62*	-0.12	-6.63*	-0.30	-4.01*	-0.11	-7.85*
Israel	-1.09	-3.15*	-0.29	-2.63*	-0.96	-4.95*	-0.08	-4.08*	0.25	-4.70*	-0.09	-25.64*	0.27	-4.70*	-0.09	-19.41*
Jordan	-0.61	-8.64*	0.11	-9.17*	-0.30	-9.42*	0.13	-10.13*	-0.71	-3.61*	0.33	-2.01**	-0.37	-5.42*	0.16	-3.71*
Korea	0.28	-0.65	0.65	-0.97	-0.78	-1.04	0.64	-0.60	-0.28	-2.01**	-1.43	-12.47*	-0.71	-2.72**	-1.52	-12.76*
Malaysia	0.19	-7.58*	0.37	-35.15*	0.08	-6.78*	0.36	-22.14*	0.47	-9.74*	0.29	-72.75*	0.30	-7.02*	0.27	-31.00*
Mexico	0.01	-4.25*	0.29	-20.90*	0.29	-2.62*	0.27	-12.22*	-0.16	-1.66	-0.30	-6.49*	0.04	-2.64*	-0.27	-9.89*
Morocco	-0.73	-4.99*	0.75	-2.22**	-0.67	-7.30*	0.83	-1.61	0.03	-4.72*	0.13	-10.65*	0.06	-8.06*	0.13	-13.36*
Pakistan	-0.16	-0.74	1.07	0.05	-0.43	-1.97**	1.74	1.23	0.52	-0.70	0.06	-16.44*	0.14	-2.54*	0.04	-13.06*
Peru	-0.22	-4.23*	0.86	-1.12	-0.38	-4.29*	0.68	-2.12*	-0.19	-1.98**	0.67	-2.85*	-0.33	-3.36*	0.68	-2.05**
Philippines	0.25	-3.34*	0.12	-39.50*	0.12	-3.84*	0.12	-26.49*	0.91	-0.28	-0.23	-36.76*	0.44	-1.87**	-0.19	-23.81*
Poland	1.47	2.05**	0.50	-10.54*	0.39	-2.00**	0.66	-4.21*	1.10	1.51	0.01	-19.96*	0.95	-0.38	0.02	-9.19*
Russia	4.81	6.15*	2.45	3.52**	1.30	0.43	0.59	-0.71	-0.28	-2.15**	-0.54	-8.02*	-0.13	-2.43*	-0.38	-6.62*
Saudi Arabia	0.05	-9.99*	0.34	-5.40*	0.22	-6.03*	0.55	-2.79*	0.22	-12.47*	0.69	-3.61*	0.28	-7.77*	0.92	-0.69
South Africa	0.31	-4.39*	0.52	-8.81*	0.28	-4.63*	0.47	-6.62*	-0.19	-7.66*	0.51	-9.03*	-0.18	-4.87*	0.51	-5.20*
Thailand	1.08	0.28	0.66	-5.69*	0.62	-1.19	0.61	-5.19*	0.82	-0.44	0.65	-3.54*	0.44	-1.63	0.56	-4.08*
Tunisia	-0.21	-1.74	0.98	-0.22	-0.07	-1.68**	0.84	-1.34	1.00	-0.01	-0.16	-6.44*	0.61	-1.54	-0.18	-12.11*
Turkey	-0.52	-1.50	0.90	-0.54	0.25	-1.42	0.80	-1.35	-0.50	-6.05*	-0.48	-6.51*	-0.09	-4.71*	-0.19	-6.09*

*, **: Significant at 5% and 10% level, respectively.

without dummy case. As we have also seen in the individual case, the significance level of the coefficients of FINOP is higher controlling for common shocks. This result with common time dummies is more reliable as it excludes the impact of common shock that are shared across individual members. Therefore, the result with common dummies has higher significance level as it is free from any common disturbance affecting our results in earlier case. The coefficient of FINOP is significantly positive in DOLS and FMOLS in most of the cases. This means, financial globalization has positive impact on growth. We have also found that the impact of trade openness on growth is positive.

Table 8: Results of Group-Mean Panel DOLS and FMOLS Estimates

Dependent Variable: LPGDP	Panel A		Panel B			
	FINOP	t-statistic	FINOP	t-statistic	TROP	t-statistic
Without Time Dummies						
Group Mean DOLS	0.59	-13.99*	0.16	-15.56*	0.66	-56.12*
Group Mean FMOLS	0.19	-14.49*	-0.14	-17.72*	0.64	-30.26*
With Common Time Dummies						
Group Mean DOLS	0.33	-15.71*	0.16	-45.78*	0.05	-153.19*
Group Mean FMOLS	0.23	-19.82*	0.11	-24.99*	0.06	-66.70*

*, **: Significant at 5% and 10% level, respectively.

Section VI
Concluding Remarks:

This study, in a unique way, examined the long-run relationship between economic growth and financial liberalization for select 27 EMEs. Unlike other studies in the literature, the study is able to use recently developed panel unit root test and cointegration test on the basis of neoclassical theory of economic growth, which links capital account liberalization with level of per capita output instead of per capita output growth. Using the cointegration tests as proposed by Pedroni, Kao and Maddala and Wu, we found that there is a dynamic long-run relationship exists between economic growth and financial openness. The results are also remained unchanged when we have controlled for trade openness contribution to per capital GDP. Further, the long-run coefficient of financial openness is estimated through panel DOLS and FMOLS, which is significantly positive. The findings are interesting to show a positive long-run relationship exists between capital account liberalisation and growth as opposed to the findings of many earlier studies.

Notes:

[1] Financial globalization, financial liberalization and financial integration are used interchangeably in this paper referring to the cross border trade of financial assets as well as deregulation of the capital account to increase foreign investors' participation in domestic financial markets and domestic investors' participation in the financial markets of the rest of the world.

[2] However, there was slowdown in capital inflows to EMEs with the onset of the recent global financial crisis.

[3] On contrary, a recent trend shows that capital flows from rich to poor countries.

[4] Behera, HK (2008) Does Financial Globalisation Spur Growth in India? A Paper presented in the 44th Annual conference of The Indian Econometric Society during January 3-5, 2008.

[5] The trend reversed as a consequence of global financial crisis starting with Lehman failure in September 2008.

[6] A discussion about the selection of 27 EMEs is given in section IV and Appendix I.

[7] Net capital flows rather than gross capital flows are used for defining Financial Globalization as net flows matters for a country's investment point of view.

[8] The list of countries in the EME classification is given in Appendix I.

[9] A detailed analysis of panel unit root test and panel cointegration test are provided in Appendix II

[10] See Appendix III for details about FMOLS and DOLS. More details are available in Kao and Chiang (1997), Mark and Sul (1999), Pedroni (2000), and Pedroni (2001).

[11] Common time dummies are incorporated in the panel DOLS and FMOLS estimations to pick up any possible shocks, such as the East Asian crisis, that might affect all the countries in sample so that to deal with cross sectional dependency.

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Appendix I: List of EME Countries

The choice of countries in the EMEs is based on the MSCI classification of emerging market economies plus Saudi Arabia. The data used in the study are for 27 countries, which are given below:

Name of the Country	Name of the Country
Argentina	Korea
Brazil	Malaysia
Chile	Mexico
China	Morocco
Colombia	Pakistan
Czech Republic	Peru
Egypt	Philippines
Hungary	Poland
India	Russia
Indonesia	Saudi Arabia
Iran	South Africa
Israel	Thailand
Jordan	Tunisia
	Turkey

Appendix II: Panel Unit Root and Cointegration Tests

Unit Root Tests

All panel unit root tests, *viz.* Im, Pesaran and Shin (1995, 2003), the Levin and Lin and Chu (2002) test and the Maddala and Wu (1999) tests are based on a Dickey-Fuller-type regression:

$$\Delta y_{it} = \alpha_i x_{it} + \rho_i y_{i,t-1} + \sum_{j=1}^{ki} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \qquad (1.1)$$

where i = 1,…,N is the country for time dimension t = 1,…,T and ε_{it} is *iid* $(0, \sigma_i^2)$

The x_{it} represent the exogenous variables in the model, including any fixed effects or individual trends or zero as well. The four tests have different alternative hypotheses, depending on different degrees of heterogeneity under the alternative hypothesis.

H_0: $\rho_i = 0$ for all i.

H_1: $\rho_i = \rho \leq 0$ for all i (for common unit root test assuming the persistence parameters are common across cross-sections)

$\rho_i = \rho_i = 1$ for each cross-section i (for individual unit root test assuming ρ_i vary freely across cross-sections).

Levin, Lin and Chu (LLC) Test:

Levin and Lin (1992) proposed a unit root test, which allows for fixed effects and unit-specific time trends in addition to common time effects (which may in practice be concentrated out of the equation). The unit-specific fixed effects are an important source of heterogeneity here since the coefficient of the lagged dependent variable is restricted to be homogeneous across all units of the panel. However, LLC has advantage over Levin and Lin test as it allows for heterogeneity of cross-sectional units. The LLC tests amount to testing for the null hypothesis H_0: $\rho_i = 0$ for all i against the alternative H_1: $\rho_i = \rho < 0$ for all i.

Taking μ_n^* as a *mean* adjustment factor and σ_n^* as a variance adjustment factor, the LLC model for (1.1), using finite sample mean and variance adjustments, is defined by

$$LLC = \frac{t_{Nn}}{\sigma_n^*} - \frac{\mu_n^* n \sum_{i=1}^{N} s_i}{\sigma_n^* \sqrt{\hat{\sigma}_{Nn}^2 \sum_{i=1}^{N} y'_{i,-1,n} M_{Qin} y_{i,-1,n} / \hat{\sigma}_{in}^2}} \tag{1.2}$$

Where s_i are the estimated standard errors from estimating each ADF in equation (1.1) and t_{Nn} statistics are t-statistics of the coefficient (ρ_i) using normalized pooled data. Values of μ_n^* and σ_n^* for various samples are simulated using generated random normal numbers and reported in Table 2 of LLC (p.14). In using the LLC test, we reject null hypothesis H_0: $\rho_i = 0$ for all i when LLC test statistic is smaller than a critical value from the lower tail of a standard normal distribution.

***Im, Pesaran and Shin (IPS) Test*:**

Im, Pesaran and Shin (1997) (IPS) allow for a heterogenous coefficients of $y_{i,t-1}$ and propose a testing procedure based on averaging individual unit root test statistics. The IPS test provides separate estimations for each i cross-section, allowing different specifications of the parametric values, the residual variance and the lag lengths.

The null hypothesis is that each series in the panel contains a unit root, *i.e.* H_0: $\rho_i = 0$ for all i and the alternative hypothesis is that at least one of the individual series in the panel is stationary, *i.e.* H_1: $\rho_i < 0$ for at least one i.

Im, Pesaran and Shin (2003) formulated their model under the restrictive assumption that T should be the same for all cross-sections, requiring a balanced panel to compute the $\bar{t}$ -test statistic. The $\bar{t}$ -statistic is the average of the individual ADF *t*-statistics ($t_{\rho i}$) for testing that $\rho_i = 0$ for all i:

$$\bar{t} = \frac{1}{N}\sum_{i=1}^{N} t_{\rho i} \tag{1.3}$$

IPS showed that under specific assumptions, $t_{\rho i}$ converges to a statistic denoted as tiT, which is assumed to be iid and that also has finite mean and variance. Accordingly, IPS suggested the computed mean $\left(E[tiT|\rho\ i=1\right)$ and variance $\left(Var[tiT|\rho\ i=1\right)$ of the tiT statistic for different values of *N* and lags included in the augmentation term of the equation (1.1). based on those values, the IPS proposed modified average t-statistic for testing unit roots in panels can be given as:

$$t_{IPS} = \frac{\sqrt{N}\left(\bar{t} - \frac{1}{N}\sum_{i=1}^{N} E[tiT|\rho\ i] = 0\right)}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} Var[tiT|\rho\ i = 0]}} \tag{1.4}$$

One can reject the null hypothesis as given above when the t_{IPS} statistic is smaller than a critical value from the lower tail of a standard normal distribution.

Maddala and Wu (MW) Test:

Maddala and Wu (1999) attempted to provide unit root test statistics, based on Fisher-type non-parametric test (1932), for unbalanced panel. They are in line with the assumptions that a heterogenous alternative is preferable, but they disagree with the use of average ADF statistics by arguing that it is not the most effective way of evaluating stationarity. Assuming that there are *N* unit root tests, the *MW* test takes the following form:

$$\Pi = -2\sum_{i=1}^{N} \ln \pi_i \tag{1.5}$$

where π_i is the probability limit values from regular DF (or ADF) unit root tests for each cross-section i. Since $-2\ln\pi_i \sim \chi^2$ with 2N d.f., where N is the number of separate samples. In order to consider the dependence between cross-sections, Maddala and Wu propose obtaining the π_i-values by using bootstrap procedures by arguing that correlations between groups can induce significant size distortions for the test. Maddala and Wu propose the methodology can be applicable to panel cointegration tests, whether they are tests using no cointegration as null, or cointegration as null (for more details, see Chapter 6 of Maddala and Kim (1998)).

Breitung (Breitung) Test:

The size of LLC is distorted if an ADF is used in the LLC instead of a simple DF. Therefore, Breitung (2000) method, which includes with heterogeneous trends and short run dynamics; but excludes autoregressive portion (and not the exogenous components) while constructing the standardized proxies:

$$\Delta\widetilde{y}_{it} = \left(\Delta y_{it} - \sum_{j=1}^{p_i} \hat{\beta}_{ij}\Delta y_{i,t-j}\right) / s_i$$
$$\Delta\widetilde{y}_{i,t-1} = \left(y_{i,t-1} - \sum_{j=1}^{p_i} \beta_{ij}\Delta y_{i,t-j}\right) / s_i \quad (1.6)$$

where $\hat{\beta}$, β and s_i are as defined for LLC.

Second, the proxies are transformed and detrended as:

$$\Delta y_{it}^{*} = \sqrt{\frac{(T-t)}{(T-t+1)}}\left(\Delta\widetilde{y}_{it} - \frac{\Delta\widetilde{y}_{i,t+1} + \cdots + \Delta\widetilde{y}_{i,T}}{T-t}\right)$$

$$y_{it}^{*} = \widetilde{y}_{it} - \widetilde{y}_{i1} - \frac{t-1}{T-1}(\widetilde{y}_{iT} - \widetilde{y}_{i1}) \quad (1.7)$$

The persistence ρ parameter is estimated from the pooled proxy equation:

$$\Delta y^{*}_{it} = \rho \; y^{*}_{i,t-1} + \nu_{i,t} \qquad (1.8)$$

Breitung shows that the resulting statistic has a standard normal distribution and more power than the LLC test. However, he shows that the proposed statistic has low power when the trend parameters are heterogeneous across units. The problem does not arise when the trend parameters are homogeneous across units.

Hadri (HD) Test:

The Hadri (2000) proposed a Langrange Multiplier (LM) procedure for panel unit root test is similar to the KPSS unit root test, and has a null hypothesis of no unit root in any of the series in the panel. Like the KPSS test, the Hadri test is based on the residuals from the individual OLS regressions of on a constant, or on a constant and a trend. His LM test is based on the 'random walk plus noise' model and can be defined by using the residuals of the following equation:

$$y_{it} = \delta_i + \mu_i t + \varepsilon_{it} \qquad (1.9)$$

where $\varepsilon_{it} = \rho_i \varepsilon_{i,t-1} + \nu_{it}$.

Using the estimated individual regression residuals $(\hat{\varepsilon})$ of model (1.9), Hadri's LM statistics is given as follows:

$$LM_1 = \frac{1}{N}\left(\sum_{i=1}^{N}\left\{\sum_t S_i(t)^2 / T^2\right\}\right) / \bar{f}_0 \qquad (1.10)$$

where $S_i(t)$ are the cumulative sums of the residuals and $\bar{f}_0$ is the average of the individual estimators of the residual spectrum at frequency zero.

An alternative form of the LM statistic allows for heteroskedasticity across i:

$$LM_2 = \frac{1}{N}\left(\sum_{i=1}^{N}\left\{\sum_{t} S_i(t)^2 / T^2\right\}\right) / f_{i0} \qquad (1.11)$$

Hadri shows that under *miid* assumptions,

$$Z = \frac{\sqrt{N}(LM - \xi)}{\zeta} \rightarrow N(0,1)$$

Where $\xi = 1/6$ and $\zeta = 1/45$, if the model only includes constants (μ_i is set to 0 for all i), and $\xi = 1/15$ and $\zeta = 11/6300$, otherwise.

Hadri test appears to over-reject the null of stationarity, and may yield results that directly contradict those obtained using alternative test statistics.

Cointegration Tests:

Kao's Cointegration Tests

Kao (1999) presents two types of cointegration tests in panel data, the Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) types. Consider a panel regression of the following type:

$$y_{i,t} = x'_{i,t}\beta + z'_{i,t}\gamma + \varepsilon_{i,t} \qquad (2.1)$$

where $x'_{i,t} = x'_{i,t-1} + e_{i,t}$ and $\varepsilon_{i,t}$ is I(1). The DF type tests from Kao (1999) can be calculated from the estimated residuals of the above equation 2.1 as:

$$\hat{\varepsilon}_{i,t} = \rho\hat{\varepsilon}_{i,t-1} + \upsilon_{i,t} \qquad (2.2)$$

where $\hat{\varepsilon}_{i,t}$ is the estimated residuals from equation 2.1. In order to test the null hypothesis of no cointegration, the null can be written as $H_0 : \rho = 1$. The OLS estimate of ρ and the *t*-statistic can be given as:

and $$\hat{\rho} = \frac{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{\varepsilon}_{i,t}\hat{\varepsilon}_{i,t-1}}{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{\varepsilon}_{i,t}^2}$$

$$t_{\rho} = \frac{(\hat{\rho}-1)\sqrt{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{\varepsilon}_{i,t-1}^{2}}}{s_{\varepsilon}} \tag{2.3}$$

where $s_{\varepsilon}^{2} = (1/NT)\sum_{i=1}^{N}\sum_{t=2}^{T}(\hat{\varepsilon}_{i,t} - \hat{\rho}\hat{\varepsilon}_{i,t-1})^{2}$. Accordingly, four DF-type tests assuming $z'_{i,t} = \{\mu_i\}$ are constructed as follows:

$$DF_{\rho} = \frac{\sqrt{N}T(\hat{\rho}-1) + 3\sqrt{N}}{\sqrt{10.2}},$$

$$DF_{t} = \sqrt{1.25}t_{\rho} + \sqrt{1.875N},$$

$$DF_{\rho}^{*} = \frac{\sqrt{N}T(\hat{\rho}-1) + (3\sqrt{N}\hat{\sigma}_{\upsilon}^{2}/\hat{\sigma}_{0\upsilon}^{2})}{\sqrt{3 + (7.2\hat{\sigma}_{\upsilon}^{4}/\hat{\sigma}_{0\upsilon}^{4})}} \quad \text{and}$$

$$DF_{t}^{*} = \frac{t_{\rho} + (\sqrt{6N}\hat{\sigma}_{\upsilon}/2\hat{\sigma}_{0\upsilon})}{\sqrt{(\hat{\sigma}_{0\upsilon}^{2}/2\hat{\sigma}_{\upsilon}^{2}) + (3\hat{\sigma}_{\upsilon}^{2}/10\hat{\sigma}_{0\upsilon}^{2})}}$$

where $\hat{\sigma}_{\upsilon}^{2} = \sum_{u} - \sum_{u\varepsilon}\sum_{\varepsilon}^{-1}$ and $\hat{\sigma}_{0\upsilon}^{2} = \Omega_{u} - \Omega_{u\varepsilon}\Omega_{\varepsilon}^{-1}$. While DF_{ρ} and DF_{t} are based on assuming strict exogeneity of the regressors with respect to the errors in the equation, DF_{ρ}^{*} and DF_{t}^{*} are for cointegration with endogenous regressors. For the ADF test, we can run the following ADF regression:

$$\hat{\varepsilon}_{i,t} = \rho\hat{\varepsilon}_{i,t-1} + \sum_{j=1}^{p}\vartheta_{j}\Delta\hat{\varepsilon}_{i,t-j} + \upsilon_{i,tp} \tag{2.4}$$

With the null hypothesis of no cointegration, the ADF test statistics can be constructed as

$$ADF = \frac{t_{ADF} + (\sqrt{6N}\hat{\sigma}_{\upsilon}/2\hat{\sigma}_{0\upsilon})}{\sqrt{(\hat{\sigma}_{0\upsilon}^{2}/2\hat{\sigma}_{\upsilon}^{2}) + (3\hat{\sigma}_{\upsilon}^{2} + 10\hat{\sigma}_{0\upsilon}^{2})}} \tag{2.5}$$

Where t_{ADF} is the t-statistic of ρ in the equation (2.4). The asymptotic distribution of DF_{ρ}, DF_{t}, DF_{ρ}^{*}, DF_{t}^{*} and ADF converge to a standard normal distribution *N(0,1)* by sequential limit theory.

Kao's test imposes homogeneous cointegrating vectors and autoregressive coefficients, but it does not allow for multiple exogenous variables in the cointegrating vector. Another drawback is that it does not address the issue of identifying the cointegrating vectors and the cases where more than one cointegrating vector exists.

Pedroni's Cointegration Tests

Pedroni (1999, 2000 and 2004) proposes several tests for cointegration in panel data models that allow for heterogeneous slope coefficients, fixed effects and individual specific deterministic trends. The test has advantage over the test procedure proposed by Kao by allowing multiple regressors, for the cointegrating vector to vary across different sections of the panel, and also for heterogeneity in the errors across cross-section units.

The panel regression model that Pedroni proposes has the following form:

$$y_{i,t} = \alpha_i + \delta_t + \sum_{m=1}^{M} \beta_{mi} x_{mi,t} + \varepsilon_{i,t} \tag{2.6}$$

Seven different cointegration statistics are proposed by Pedroni to capture within and between effects in the panel, and the tests can be classified into two category. The first test involves averaging test statistics for cointegration in the time series across cross-sections. It includes four tests based on pooling along the 'within' dimension (the first-order autoregressive term is assumed to be the same across all the cross sections). The test statistics of these tests are given below:

1. Panel ν - Statistic: $$T^2 N^{3/2} Z_{\hat{\nu}\, N,T} = \frac{T^2 N^{3/2}}{\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{\varepsilon}_{i,t-1}^2} \tag{2.7}$$

2. Panel ρ -Statistic: $$T\sqrt{N} Z_{\hat{\rho}\, N,T^{-1}} = \frac{T\sqrt{N} \{ \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} (\hat{\varepsilon}_{i,t-1} \Delta \hat{\varepsilon}_{i,t} - \hat{\lambda}_i) \}}{\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{\varepsilon}_{i,t-1}^2} \tag{2.8}$$

3. Panel t – Statistic (non-parametric):

$$Z_{t\,N,T} = \frac{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}(\hat{\varepsilon}_{i,t-1}\Delta\hat{\varepsilon}_{i,t}-\hat{\lambda}_i)}{\sqrt{\tilde{\sigma}_{N,T}^{2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{\varepsilon}_{i,t-1}^{2}}} \quad (2.9)$$

4. Panel t – Statistic (parametric):

$$Z_{t\,N,T}^{*} \equiv \frac{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{\varepsilon}_{i,t-1}^{*}\Delta\hat{\varepsilon}_{i,t}^{*}}{\sqrt{\tilde{s}_{N,T}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{\varepsilon}_{i,t-1}^{*2}}} \quad (2.10)$$

The second category includes three tests based on pooling the 'between' dimension (averaging the AR coefficients for each member of the panel for unit root test on residuals) and the parameter is allowed to vary over the cross sections. In these tests, therefore, the averaging is done in pieces so that the limiting distributions are based on limits of piecewise numerator and denominator terms. These test statistics can be given as:

5. Group ρ - Statistic:

$$TN^{-1/2}\tilde{Z}_{\hat{\rho}N,T^{-1}} \equiv TN^{-1/2}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{\varepsilon}_{i,t-1}^{2}\right)^{-1}\sum_{t=1}^{T}(\hat{\varepsilon}_{i,t-1}\Delta\hat{\varepsilon}_{i,t}-\hat{\lambda}_i) \quad (2.11)$$

6. Group t- Statistic (non-parametric):

$$N^{-1/2}\tilde{Z}_{t\,N,T} \equiv N^{-1/2}\sum_{i=1}^{N}\left(\hat{\sigma}_i^{2}\sum_{t=1}^{T}\hat{\varepsilon}_{i,t-1}^{2}\right)^{-1/2}\sum_{t=1}^{T}(\hat{\varepsilon}_{i,t-1}\Delta\hat{\varepsilon}_{i,t}-\hat{\lambda}_i) \quad (2.12)$$

7. Group t- Statistic (parametric):

$$N^{-1/2}\tilde{Z}_{t\,N,T}^{*} \equiv N^{-1/2}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{s}_i^{*2}\hat{\varepsilon}_{i,t-1}^{*2}\right)^{-1/2}\sum_{t=1}^{T}\hat{\varepsilon}_{i,t-1}^{*}\Delta\hat{\varepsilon}_{i,t}^{*} \quad (2.13)$$

A major drawback of the above procedure is the restrictive *a priori* assumption of a unique cointegrating vector.

Appendix III: Panel FMOLS and DOLS Tests

Fully Modified OLS (FMOLS) Mean Group Panel Estimator

The precise equation estimated with FMOLS can be derived from the following equation:

$$y_{it} = \alpha_i + x_{it}^{'}\beta + u_{it}\text{, } i = 1, \ldots, N;\ t = 1, \ldots, T.$$

$$x_{it} = x_{it-1} + \varepsilon_{it}$$

Where y is the dependent variable (LPGDP in our case) and x is the regressor (FINOP, TOP in our case) and the vector of error process $\xi_{it} = (u_{it}, \varepsilon_{it})$ is stationary with asymptotic covariance matrix Ω_i, which can be decomposed as $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i^{'}$. Here, Ω_i^0 is the contemporaneous covariance and Γ_i is a weighted sum of autocovariances. Thus, the variables y_i, x_i are said to be cointegrated for each member of the panel, with cointegrating vector β if y_{it} is integrated of order one. The term α_i allows the cointegrating relationship to include member specific fixed effects. If y_{it} and x_{it} are cointegrated, the between-dimension panel FMOLS estimator can be expressed as:

$$\hat{\beta}_{FMOLS,i} = \left[\sum_{i=1}^{T} x_{ij}^{*} x_{ij}^{*'}\right]^{-1} \left[\sum_{i=1}^{T} x_{ij}^{*} y_{it}^{*} - T\hat{\gamma}_i\right]$$

where $y_{ij}^{*} = (y_{it} - \bar{y}_i)$; $x_{ij}^{*} = (x_{it} - \bar{x}_i)$; and

$$\bar{y}_i = N^{-1}\sum_{t=1}^{T} y_{it}\ ;\ \bar{x}_i = N^{-1}\sum_{t=1}^{T} x_{it}^{'}$$

$$y_{it}^{*} = y_{ij}^{*} - \hat{\Omega}_{u\varepsilon}\hat{\Omega}_{\varepsilon}^{-1}\hat{\Omega}_{\varepsilon u}\ ;\ \hat{\gamma}_i = \hat{\Gamma}_{\varepsilon u} - \hat{\Gamma}_{\varepsilon u}\hat{\Omega}_{\varepsilon}^{-1}\hat{\Gamma}_{u\varepsilon};$$

Pedroni's between-dimension group mean panel FMOLS estimator, which is the average of the conventional FMOLS estimator of the individual member of the panel, can be expressed as:

$$\hat{\beta}_{GFMOLS} = N^{-1}\sum_{i=1}^{N} \beta_{FMOLS,i}\ .$$

The associated t-statistic for the between dimension estimator is:

$$t_{\hat{\beta}_{GFMOLS}} = N^{-1/2} \sum_{i=1}^{N} t_{\hat{\beta}_{FMOLS,i}} \text{, where}$$

$$t_{\hat{\beta}_{FMOLS,i}} = (\hat{\beta}_{FMOLS,i} - \beta_0)\left(\bar{\Omega}_u^{-1} \sum_{i=1}^{T} (x_{it} - \bar{x}_i)^2 \right)^{1/2}.$$

Dynamic OLS (DOLS) Mean Group Panel Estimator

Pedroni (2001) proposed between-dimension estimator based on average of the panel DOLS estimator 'Group Mean DOLS' that can be obtained from the following regression:

$$y_{it} = \alpha_i + \beta_i x_{it} + \sum_{k=-K_i}^{K_i} \gamma_{ik} \Delta x_{it-k} + u_{it}^*$$

From the above regression, the Group-Mean panel DOLS estimator can be constructed as:

$$\hat{\beta}_{DOLS_i}^* = \left[N^{-1} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} z_{it} z_{it}^{'} \right)^{-1} \left(\sum_{t=1}^{T} z_{it} \tilde{y}_{it} \right) \right]$$

Where z_{it} is the $2 \times (K+1) \times 1$ vector of regressors and $z_{it} = (x_{it} - x_i, \Delta x_{it-k}, \ldots, \Delta x_{it+k})$, $\tilde{y}_{it} = y_{it} - \bar{y}_i$. The between-dimension Group-Mean DOLS estimator can be constructed by applying the conventional DOLS estimator to the *i*th member of the panel as:

$$\hat{\beta}_{GDOLS}^* = N^{-1} \sum_{i=1}^{N} \beta_{DOLS,i}^*$$

where $\beta_{DOLS,i}^*$ is the conventional DOLS estimator applied to the *i*th member of the panel. Taking the $\hat{\sigma}_i^2 = \lim_{T \to \infty} E\left[T^{-1} (\sum_{t=1}^{T} u_{it}^*)^2 \right]$ as the long-run variance of the residuals from the DOLS regression, the associated t-statistic for the between-dimension estimator can be stated as:

$$t_{\hat{\beta}_{DOLS}^*} = N^{-1/2} \sum_{i=1}^{N} t_{\hat{\beta}_{DOLS,i}^*} \text{, where}$$

$$t_{\hat{\beta}_{DOLSi}^*} = (\hat{\beta}_{DOLSi}^* - \beta_0)\left(\hat{\sigma}_i^{-2} \sum_{t=1}^{T} (x_{it} - \bar{x}_i)^2 \right)^{1/2}$$

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Estimation of Potential Output in India

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Potential output refers to the highest level of output that can be sustained over the long term. It is assumed that the existence of a limit of output is due to natural and institutional constraints. If actual GDP rises and stays above potential output, then (in the absence of wage and price controls) inflation tends to increase as demand exceeds supply. Likewise, if output is below potential level, inflation will decelerate as suppliers lower prices to fill their excess production capacity. The issue of estimating potential output is, therefore, critically important in understanding the overall inflationary dynamics of the economy. Against this background, this paper presents empirical estimates of potential output in India using several advanced econometric methods based on both monthly and quarterly data. Selection of an appropriate method is validated against its out-of-sample forecasts as well as from the spectral density properties. For monthly data, the estimate of the potential growth rate for the Indian economy is found to converge within the range 9.4 percent to 9.7 percent for most of the methods. For quarterly data, these methods consistently produce potential output near to 9.0 percent. The diagnostics of the empirical methodologies suggest that unobserved component models are most efficient methods for estimation of quarterly potential output.

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Introduction

The overall stance of monetary and credit policy in India is to provide adequate liquidity to meet genuine credit requirements and support investment demand in the economy while keeping the price level within limit. One of the major issues in the formulation of the monetary policy is to determine whether the economy is operating above or below its maximum sustainable level. The path of the maximum sustainable level, commonly known as the potential output, indicates that level of output that is consistent with stable price level. In other words, potential output is the maximum output an economy could

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produce without putting pressure on price level. It is that level of output at which the aggregate demand and supply in the economy are balanced, so that, inflation tends to its long-run expected value, if other factors remain constant. Once potential (capacity) output is estimated, the capacity utilization rate can be constructed as a ratio of the actual level of output to the potential output. The capacity utilization generally conforms to that of a full input point on a production function with the qualification that capacity represents a realistically sustainable maximum level of output for a given industry, rather than some higher unsustainable short term maximum.

Output gap, which is the discrepancy between the actual output and the potential output, indicates the presence of disequilibrium in the economy. When the actual output exceed the potential output, i.e. the output gap becomes positive, the rising demand leads to an increase in the price level, if temporary supply factors are held constant. Such instances are seen as a source for inflationary pressures and as a signal for the central bank to tighten monetary policy. In case of a negative output gap, inflation tends to fall. The idea of potential output is, therefore, essential to capture the process of inflation dynamics in the economy. However, potential output cannot be observed directly and needs to be estimated.

The objective of this study is to estimate the potential output for the Indian economy using various univariate and multivariate techniques. Both annual and quarterly data of output [Gross Domestic Product (GDP)] are used to estimate the potential output, both at the aggregate and at the three prime sector level, viz., agriculture and allied, industry and services sectors. Selection of the method to estimate potential output is done through the application of spectral analysis as well through regression analysis. The method that explains the larger proportion of spectral mass in the range of business cycle frequencies (i.e. from 5 quarters to 32 quarters or 15 months to 96 months) is selected for estimation of the potential output. Alternatively, the estimate of output gap, which explains maximum inflation or is having minimum root mean square error (RMSE) is selected to estimate the potential output.

The rest of the paper is organized as follows: a priori the debate on the use of potential output as a variable for demand pressure is presented in Section I. Methodological developments, with special emphasis to recent literature, over a historical perspective are provided in Section II. Section III reviews a few recent empirical literatures at the national as well as international level. Empirical estimates of potential output in India under various methods are presented in Section IV. Finally, Section V concludes the paper with a few policy implications.

Section I
Potential Output and Inflation: Alternative Views

If the real output grows rapidly in the future, the competition for scarce productive resources could put upward pressure on wages and other production costs and ultimately inflation could be raised. Most economic forecasters believe inflationary pressures build after potential output rises above a certain level. Some analysts, however, claimed that the historical relationship is no longer valid because the present economies are more open today and hence allowing imported goods to relieve any shortage of domestic capacity. Inflationary pressures typically emerge when the overall demand for goods and services grows faster than the supply, causing a decrease in the amount of unused productive resources, or economic slack mostly captured through unemployment rate, which measures unused resources in the labour market. Inflationary pressures can be judged by comparing the current capacity utilization rate with an estimated stable inflation rate. When capacity utilization is at the stable inflation rate, inflation tends neither to increase nor to decrease. The concept is similar to the natural rate of unemployment, the unemployment rate for which inflation neither increases nor decreases, but uses capacity utilization rather than unemployment as the measure of economic slack.

Some analysts contend that potential output has become a less dependable indicator of inflationary pressures. Critics of it believe that potential output as an inflation indicator tend to over simplify the description of both monetary policy formulation and the inflationary process. For example in an article appeared in the Wall Street Journal on February 14, 1995, it is indicated that monetary policy should not be guided by using capacity utilization as an indicator of inflation. It is argued that, in practice, a simple relationship between capacity utilization and the overall inflation rate may not exist. Influences on inflation other than resource utilization routinely appear in economic models. Economic developments abroad and foreign exchange rate swings can effect domestic inflation directly through changes in prices of imports and indirectly through competing goods effects on domestic strategic price setting behavior. Therefore, use of potential output as a variable indicating demand pressures has its own limitations.

Section II
A Review of Methodology and Literature

At the outset it may be stated that, though the concept is theoretically appealing, empirical estimation of potential output is not straight forward. It has a long history and still remains a topic of intense debate. Accordingly, the methodology presented here provides a broad literature review over the developments of nearly five decades. In particular, we present a synoptic view of various techniques those are developed since 1960, excluding typical survey-based measures of capacity variables.

II.1 Early Developments

In an early attempt, Klein (1960) and Klein and Summers (1967), while working at the Wharton School of Finance and Commerce at Pennsylvania University, evolved a methodology (which was subsequently called as "Wharton School Technique") to estimate the potential output and capacity utilization rates relating to the US economy. They defined the capacity of an industry as the maximum sustainable level of output the industry can attain within a very short time if the demand for its product were not a constraining factor, when the industry is operating its existing stock of capital at its customary level of intensity. Subsequently, many other organizations in US, viz., the US Department of Commerce, the Bureau of Census, etc., also started computing potential output series based on the similar methodology. This method uses time series data only on output and involves marking of peak levels of output and fitting piece-wise linear function by joining successive peaks with straight line to estimate the trend in potential output. For the points before the first peak and after the last peak, capacity output are estimated by extrapolation of the fitted curve. The method is also known as trend-through-peaks method. Despite the simplicity and easiness in implementation, a major drawback of the method is that it does not establish any links between output and other economic variables, like actual supplies of inputs, technological progress, etc., which might have impact on capacity output. Besides, this approach relies on the existence of recent peaks in output in order to provide up-to-date/updated estimates of capacity output. The method, therefore, seems incapable of accounting for situations arising out of prolonged recession or stagnation.

Interest in measuring the capacity output for the Indian economy goes back to 1970s (Divatia and Varma, 1970). They concentrated on the manufacturing industries in India and their estimate of the capacity variables covering the period 1960-68 was published in the RBI Bulletin, April, 1970. The methodology suggested by them is actually a modified version of Wharton School Index in which monthly data (without seasonal adjustment) instead of quarterly indices (quarterly average of monthly seasonally adjusted series) was used. Moreover, in this approach, peak monthly production indices in a year are taken as potential production for all the months of the year. Thus the estimated potential production function shows several discrete jumps at the time points corresponding to changes in the level of potential production. Though, their method provides a useful alternative measure of potential utilization, it was severely criticized mainly on sustainability ground. Moreover, when several firms are aggregated at the industry level, discrete jump is an unrealistic assumption - a smooth curve as suggested by Wharton School method may be a more faithful description of the reality in this case. Apart from these drawbacks, the method also fails to establish any macro-economic linkage among various production-related variables.

The National Conference Board (NCB) of the US adopted a technique for estimating capacity output on the basis of capital-output ratios. The basic assumption made in this approach is that the lowest capital output ratio corresponds to the capacity output. The estimates of capacity output are then obtained from capital stock divided by minimum capital output-ratio. This approach show significant improvements over Wharton School technique, in a sense that they make use of at least one important input, capital stock, to estimate capacity output. However, the reliability of these measures depends heavily on the accuracy of the measurement of capital, which in practice is really formidable. Secondly, it ignores various other important factors, viz., the impact of technological innovations on output, the impact of labour productivity and labour availability constraint on output, etc.

Subsequently, Klein and Preston (1967) proposed a sector-oriented production function approach (also known as growth accounting approach) for estimation of potential output. As per this approach, the potential output is defined as a full output which could be produced during any given time if all inputs are fully utilized. Accordingly, for each sector of the economy, actual output is expressed as a function of man-hours employed, real utilized capital and a proxy for technical change. Capacity output is then calculated by using (i) available man-hours (including fractional unemployment) in place of man-hours employed and (ii) fully utilized capital (i.e. available capital) in place of utilized capital in these estimated production functions (without re-estimating the parameters). Conceptually, this technique is very sound and is improvement over the methods stated above in the sense that it correlates output with related economic variables. However, it has the limitations involved in estimating the production function. In addition, it is difficult to determine real capital utilized and available man-hours at different sector/industry level. Moreover, this technique ignores the impact of total factor productivity on output.

The Organization for Economic Co-operation and Development (OECD), France, adopted a technique which is considered as improvement over the production function approach suggested by Klein and Preston (1967). In first step, the OECD uses actual capital (instead of using utilized capital as done by Klein and Preston) along with labour to explain output in the production function. In the second step, the capacity output are estimated by replacing the employed labour with the labour force (or potential employment) in the estimated production function giving due importance to the total factor productivity (in contrast Klein and Preston ignored the use of total factor productivity).

II.2 Recent Developments

Since early 1980s, two basic methodologies viz., statistical de-trending and estimation of structural relationships are extensively used for estimating potential output. In addition, recent years have witnessed applications of dynamic stochastic general equilibrium (DSGE) models for estimation. The statistical de-trending method attempt to separate a time series into permanent (trend) and cyclical components, whereas, the structural relationships method (basically a variant of production function approach) attempt to isolate the effects of structural and cyclical influences on output, using economic theory.

In practice, both univariate and multivariate approaches are applied. The univariate approach includes the Beveridge and Nelson, decomposition (1981), Univariate Unobserved Components (UUC) model (Watson, 1986; Clark, 1987), Band-Pass (BP) filter (Baxter and King, 1995) and Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997). The multivariate approach includes the Production Function, Structural Vector Auto-regression (SVAR) and Multivariate Unobserved Components (MUC) model. These methods are discussed below:

II.2.1. The Hodrick-Prescott (HP) filter

The Hodrick-Prescott (HP) filter is a simple statistical smoothing procedure and has become popular because of its flexibility in extracting a trend from macro economic data. HP filter fits a trend line through all the observations of the given series, regardless of any structural breaks that might have occurred, by making the regression coefficients themselves vary over time. This is done by finding a trend output that minimizes a combination of the gap between actual output and the trend output at any time and the rate of change in trend output at the last point of time (T).

More precisely for a given actual output Y(t), the trend output Y*(t) is estimated by minimizing

$$\sum_{t=1}^{T}\left(Y(t)-Y^*(t)\right)^2+\lambda\sum_{t=2}^{T-1}\left[\left(Y^*(t+1)-Y^*(t)\right)-\left(Y^*(t)-Y^*(t-1)\right)\right]^2$$

Where λ is a weighting factor that determines the degree of smoothness of the trend. A low value of λ will produce a trend output that follows actual output more closely, whereas a high value of λ reduces sensitivity of the trend output to short term fluctuations in actual output and in the limit the trend tends to the mean growth rate for the whole estimation period. Though a lot of subjectivity is involved in determining the appropriate value of λ depending upon the nature of the series, it is set to 14400 for monthly data, 1600 for quarterly data and 100 for annual data. The properties and shortcomings of the HP filter have been well documented (Harvey and Jaeger, 1993). The advantage of the HP filter is that stationary is retained for the output gap over a wide range of smoothing values and it allows the trend to change over time. HP filter has several drawbacks, including the arbitrary choices of the smoothing parameter λ and having high end sample biases.

II.2.2. Beveridge-Nelson (BN) Decomposition

Trend cycle decomposition is motivated by the idea that the log of aggregate output is usefully thought of as the sum of components that accounts for long term growth and a stationary, transitory deviation from trend[1]. Beveridge-Nelson (BN) decomposition is a detrending method using unobserved components. Output is assumed to contain unobserved permanent component consisting of a random walk with drift and temporary component consisting of a stationary autoregressive process. BN decomposition implies that much of the variation in output is variation in trend, while the cycle component is small and noisy. BN decomposition assumes a perfect negative correlation between trend and cycle innovations that is a property of the estimated trend and cycle, not the unobserved components.

Consider an ARMA(p,q) model for the changes in output:

$$\phi(L)\Delta y_t = c + \theta(L)\varepsilon_t, \quad \varepsilon_t \sim \text{iid N}(0,\sigma^2),$$

where $\phi(L) = 1 - \phi_1 L - \phi_2 L^2 - \ldots - \phi_p L^p$

$\theta(L) = 1 + \theta_1 L + \theta_2 L^2 + \ldots + \theta_q L^q$

and where $|\ \phi\ | < 1$ and $|\ \theta\ | < 1$.

Note that the BN trend for the ARMA model may be derived from its moving average representation (Wold form) as:

$$\Delta y_t = \mu + \psi(L)\varepsilon_t \text{ where } \psi(L) = \phi(L)^{-1}\theta(L) = \sum_{j=0}^{\infty}\psi_j L^j .$$

This ARMA form fully describes the joint distribution of the $\{y_t\}$ and therefore the conditional distribution of future observations given the past are unique. The BN decomposition is given by:

$$y_t = y_0 + \delta\ t + \psi(1)\sum_{j=1}^{t}\varepsilon_j + \tilde{\varepsilon}_t$$

where $\tilde{\varepsilon}_t = \psi(L)\varepsilon_t, \psi(L) = \sum_{k=0}^{\infty}\psi_k L^k, \psi_k = -\sum_{j=k+1}^{\infty}\psi_j,$

$TD_t = y_0 + \delta\ t$ = deterministic trend,

$TS_t = \sum_{j=1}^{t}\varepsilon_j$ = stochastic trend,

and $C_t = \tilde{\varepsilon}$ = temporary or cyclical component.

To proceed with the decomposition, an ARMA(p,q) is estimated on the changes in output. Various ARMA models are estimated and the Schwarz criterion is used to select the best model. Then the series is decomposed into stationary and trend components using the BN decomposition technique described above.

II.2.3. Unobserved Components (UC) Model

The Unobserved Components (UC) approach introduced by Harvey (1985) and Clark (1987), implies a very smooth trend and a cycle that is large in amplitude and highly persistent. The UC model decomposes the output y_t into two independent components[2]: a stochastic trend component, τ_t and a cyclical component, c_t.

$$y_t = \tau_t + c_t$$

The stochastic trend $\{\tau_t\}$ assumed to be a random walk with mean growth rate μ.

$$\tau_t = \mu + \tau_{t-1} + \eta_t , \quad \eta_t \sim \text{i.i.d.N}(0, \sigma_\eta^{\;2})$$

In some implementations the rate of drift μ is also allowed to evolve as a random walk and sometimes an irregular term is added, although these changes have little influence on the estimated cycle component for output.

The cyclical component $\{c_t\}$ assumed to be a stationary and invertible ARMA(p,q) process with innovations that may be contemporaneously cross correlated with trend innovations.

$$\phi_p(L)c_t = \theta_q(L)\varepsilon_t , \; \varepsilon_t \sim \text{i.i.d.N}(0, \sigma_\varepsilon^2),$$

$$Cov(\eta_t , \varepsilon_{t\pm k}) = \begin{cases} \sigma_{\eta\varepsilon} \;\; for \;\; k = 0 \\ 0 \;\; otherwise \end{cases}$$

Harvey *op. cit.*, Clark *op. cit.* and Harvey and Jaeger (1993) suggest specifying p=2 and q=0, which allows the cycle process to be periodic in the sense of having a peak in its spectral density function.

This set up implies that trend and cycle innovations are uncorrelated. Thus the model is augmented to include the condition $\sigma_{\eta\varepsilon} = 0$. Therefore,

$$c_t = \phi_1 c_{t-1} + \phi_2 c_{t-2} + \varepsilon_t;\ \varepsilon_t \sim \text{i.i.d.N}(0, {\sigma_\varepsilon}^2),$$

$$E(\eta_t, \varepsilon_s) = 0 \textit{ for all } t \textit{ and } s$$

where the roots of $\left(1 - \phi_1 L - \phi_2 L^2\right) = 0$ lie outside the unit circle. Taking both τ_t and c_t as unobserved state variables, this model could be written in the state space form as follows:

$$y_t = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} \tau_t \\ c_t \\ c_{t-1} \end{bmatrix}$$

$$\begin{bmatrix} \tau_t \\ c_t \\ c_{t-1} \end{bmatrix} = \begin{bmatrix} \mu \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & \phi_1 & \phi_2 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \tau_{t-1} \\ c_{t-1} \\ c_{t-2} \end{bmatrix} + \begin{bmatrix} \eta_t \\ \varepsilon_t \\ 0 \end{bmatrix}$$

The parameters are estimated from data $(y_1, y_2, \ldots, y_n)$ by the maximum likelihood method of Harvey (1981) based on the prediction error decomposition. Given estimated parameters, the Kalman filter generates the expectation of the trend (and cycle) conditional on data through time t:

$$\hat{\tau}_{t/t} = E\left[\tau_t / \Omega_t\right] \text{ and } \hat{c}_{t/t} = E\left[c_t / \Omega_t\right], \text{ where } \Omega_t = \left(y_1, y_2, \ldots, y_t\right).$$

II.2.3.1 Formulation of the problem under Multivariate Unobserved Components (MUC) setup

In general, estimation of potential output using multivariate unobserved components model is explored through the Monetary Condition Index[3] (MCI). The MCI captures the general orientation of the monetary policy affecting the aggregate demand with the objective to control the inflation rate. Considering the MCI index as an exogenous variable, the aggregate demand equation has been assumed to be a function of MCI. The observed output, y_t, has been decomposed into two parts: μ_t^y, the permanent trend (potential output) and z_t, the temporary trend reverting component (output gap).

$$\log(y_t) = \mu_t^y + z_t + e_{1t}, \quad E(e_{1t}) = 0, \quad Var(e_{1t}) = \sigma_{e1}^2 \tag{1}$$

The potential output is modeled as local linear trend.

$$\mu_t^y = \mu_{t-1}^y + \beta_{t-1}^y + \eta_{1t}, \; E(\eta_{1t}) = 0, \qquad Var(\eta_{1t}) = \sigma_{\eta 1}^2 \tag{2}$$

$$\beta_t^y = \beta_{t-1}^y + \varsigma_{1t}, \qquad E(\varsigma_{1t}) = 0, \qquad Var(\varsigma_{1t}) = \sigma_{\varsigma 1}^2 \tag{3}$$

The Wholesale price index (WPI) has been decomposed into two parts: the forecastable core part and the stochastic non-core part.

$$\log(WPI_t) = \mu_t^{core} + e_{2t}, \quad E(e_{2t}) = 0, \quad Var(e_{2t}) = \sigma_{e2}^2 \tag{4}$$

The output gap dynamics have been assumed to be influenced by the MCI and price level core part dynamics have been influenced by the output gap as well as the cost of industrial production and crude oil prices,

$$z_t = \phi_1 z_{t-1} + \phi_2 MCI_t + \varepsilon_t, \quad E(\varepsilon_t) = 0, \qquad Var(\varepsilon_t) = \sigma_\varepsilon^2 \tag{5}$$

$$\mu_t^{core} = \mu_{t-1}^{core} + \delta_1 z_{t-1} + \delta_2 \log(INDRM_{t-1}) + \delta_3 \log(Indian\_Oil_{t-2}),$$
$$E(e_{2t}) = 0, \quad Var(e_{2t}) = \sigma_{e2}^2 \tag{6}$$

The model, consisting of the equations from (1) to (6), can be re-written in its state-space realization and can be estimated by using the Kalman filter and maximum likelihood.

II.2.4. The Band-Pass (BP) Filter

An ideal low-pass filter removes high-frequency cycles from the data, whereas an ideal high-pass filter removes low frequencies from the data and an ideal band-pass filter removes both low and high frequencies. The Baxter and King (1995) filter is a band-pass filter of finite order K which is optimal in the sense that it is an approximate band-pass filter with trend reducing properties and symmetric weights.

The BP filter is designed to pass through components of time series with fluctuations between 6 and 32 quarters while removing higher and lower frequencies.

It is a finite approximation of an infinite moving average filter:

$$\tilde{y}_t = \sum_{h=-K}^{K} a_h L^h y_t$$

where $\tilde{y}_t$ is the filtered time series from the original time series y_t and a_h are the weights.

The weights a_h can be derived from the inverse Fourier transform of the frequency response function. Baxter and King adjust the band-pass filter with a constraint that the gain is zero at zero frequency. This constraint implies that the sum of the moving average coefficients must be zero. Thus, the weights a_h are obtained by solving the minimization problem:

$$\underset{a_h}{Min}\ \ Q = \int_{-\pi}^{\pi} |\ \beta(\omega) - \alpha(\omega)\ |^2\ d\omega, \text{ such that } \alpha(0) = 0.$$

Where $\beta(\omega)$ is the Fourier transform of an 'ideal' filter with cut off frequencies ω_1 & ω_2 and $\alpha(\omega)$ is the Fourier transform of the approximate filter.

Solving the minimization problem leads to:

$$a_h = b_h + \theta;\ h = 0,\ \pm 1,\ \pm 2,\ \ldots,\ \pm K$$

Where b_h are the weights of the ideal low-pass filter and θ is a constant that depends on the maximum lag length, K and are given by:

$$b_0 = \frac{\omega_2 - \omega_1}{\pi}\ \ \textit{and}\ \ b_h = \frac{1}{h\pi}(\sin\ \ \omega_2 h - \sin\ \ \omega_1 h)\ \ \textit{for}\ h = \pm 1,\ \pm 2,\ \ldots$$

$$\theta = \frac{-\sum_{h=-K}^{K} b_h}{2K+1}$$

Baxter and King propose setting K=12, $\omega_1 = 2\pi\frac{1}{32}$ and $\omega_2 = 2\pi\frac{1}{6}$ or $2\pi\frac{1}{2}$ for quarterly data and K=3, $\omega_1 = 2\pi\frac{1}{8}$ and $\omega_2 = \pi$ for annual data. The filtered series is the cyclical component and the trend component is just the difference between the actual series and the cycle.

II.2.5. The Production Function Approach

In the view of macro economic analysis, the most important limitation of all the above methods is that they are largely mechanistic and bring to bear no information about the structural constraints and limitations on production through the availability of production factors or other endogenous influences. Thus, the above methods may be inconsistent with what is known or being assumed about the growth in capital, labour supply or factor productivity or may be unsustainable because of inflationary pressures. The production function approach attempts to overcome these shortcomings while adjusting also for the limiting influence of demand pressure on employment and inflation.

In its simplest form, this approach postulates a two factor Cobb-Douglass production function for the business sector with proxy for technical change:

$$\log(Y) = \log(C) + \delta\, t + \alpha \log(L) + (1-\alpha)\log(K) + \log(E)$$

i.e., $y = c + \delta\, t + \alpha\, l + (1-\alpha)\, k + e$

where Y, L and K are the value added, labour input and capital stock of the business sector respectively, E is the total factor productivity, C, δ are constants and α is average labour share parameter. Lower case letters indicate natural logarithms.

The above production function is estimated at different sub sector level, for given sample average labour shares. The estimated residuals from these equations are then smoothed to give measures of trend total factor productivity, e*. The trend total factor productivity series, e*, is substituted back into the production function along with actual capital stock, k, and estimates of potential employment, l*, as:

$$y^{*} = c + \alpha\ l^{*} + (1-\alpha)\ k + e^{*}$$

II.2.6. Structural Vector Autoregression (SVAR) system

The SVAR method uses information from a number of variables that may be considered to have a high degree of relationship, such as GDP, capacity utilisation and domestic inflation, to estimate the potential GDP and output gap. The SVAR methodology utilizes the relationship between inflation and growth to distinguish between permanent and transitory movement in output – faster growth with lower inflation indicates that the economy at that time is operating below potential, while the emergence of inflation in the face of growth suggest that output is above potential.

In the present study, the estimate of SVAR is done following the methodology of Blanchard and Quah (1989), with the exception that inflation is used in place of the unemployment rate. By imposing identifying restrictions on the relationship between output and inflation, the regression residuals are divided into the effects of supply and demand shocks in each period on output and inflation. The output gap is then defined as the component of the forecast error of output attributed to the demand shock – the shortfall or surplus of output above or below potential due solely to demand side factors.

The SVAR identifies restriction on the long-run effects of shocks on output and inflation, while the effects of both shocks are left unconstrained in the short-run[4]. The restrictions imposed are that demand shocks affect the long-run price level but not the long-run output level, while supply shocks can have permanent effects on both output and price level. Thus a positive supply shock leads to a permanent increase in the GDP level, while a positive demand shock leads to higher output in the short-run.

As the impact of output growth on inflation can be observed with a time lag, the variables used in SVAR are the contemporaneous growth rate of output and two quarters ahead change in price level. Let z be a vector of two stationary variables $z_t = \{\Delta y_t, \Delta p_t\}$, where y_t is GDP and p_t is the domestic price level. Then the variables can be written as a function of the underlying structural shocks,

$$z_t = B_0\varepsilon_t + B_1\varepsilon_{t-1} + B_2\varepsilon_{t-2} + ---- = \sum_{j=0}^{\infty} B_j\varepsilon_{t-j}$$

where B is a (2x2) matrix of coefficients and ε_t is white noise residuals that capture demand and supply shocks. The model identifies two structural shocks: one demand shock and the other supply shock. It is assumed that the demand shock does not have a long-term effect on output, but that they allow for a more persistent effect on GDP. The supply shock is assumed to have a long-term effect on GDP.

By arranging the two uncorrelated structural shocks as

$$\varepsilon_t = \{\varepsilon_t^S, \varepsilon_t^D\}$$

where ε_t^S is an aggregate supply shock and ε_t^D is an aggregate demand shock, the change in GDP can be written as,

$$\Delta y_t = \sum_{j=0}^{\infty} \beta_{1j}\varepsilon_{t-j}^S + \sum_{j=0}^{\infty} \beta_{2j}\varepsilon_{t-j}^D$$

The restriction that aggregate demand shocks cannot have a long-term effect on GDP, is implemented by imposing $\sum_{j=0}^{\infty} \beta_{2j} = 0$.

In a SVAR model, potential GDP (the long-term trend) is represented by the term $\sum_{j=0}^{\infty} \beta_{1j}\varepsilon_{t-j}^S$, which is accumulated supply shocks, while the output gap is the share of GDP that is explained by the demand shock.

II.2.7. Dynamic Stochastic General Equilibrium (DSGE) Approach

Dynamic Stochastic General Equilibrium (DSGE) models contain many features of the real business cycle literature and allow for rigidities and imperfections in markets (these are often referred to as New Keynesian models). These provide more-realistic, yet still theoretically elegant, representations of the economy, and their development has been an exciting area of research in macroeconomics in recent years. Under this approach, potential output is defined as the level of output that an economy could attain if the inefficiencies resulting from nominal wage and price rigidities were removed. That is, if wages and prices were fully flexible. The definition of potential output as a flexible price equilibrium has much in common with the more conventional definition. The DSGE definition accords with the idea that potential output is the level of output at which inflation tends neither to rise nor to fall. However, the DSGE view of potential output also has important differences with the earlier approaches to estimating potential output. For example, in many DSGE models, potential output can undergo swings over the business cycle, a result that should not be surprising considering that the early real business cycle models viewed the business cycle as being primarily an efficient response to shocks to the economy. In addition, fiscal policy shocks, changes in households' preferences with regard to saving and consumption, changes in preferences about leisure that affect labour supply, and terms-of-trade shocks can all cause potential output to fluctuate. In contrast, production function (growth-accounting) approaches to estimating potential output generally assume that such shocks have no important effects on potential output at business-cycle frequencies (Mishkin, 2007). As a consequence, their estimates typically have smaller fluctuations than measures of potential output derived from DSGE models, and thus the output gaps in the current generation of DSGE models tend to be less variable than conventional measures and can be quite different for particular periods (Neiss and Nelson, 2005; Edge, Kiley and Laforte, 2007).

Section III
Recent Empirical Literature

Empirical literature on estimation of potential output is large and growing rapidly. Most central banks, especially in developed nations, critically monitor the trends in potential output. Instead of using a single approach, several approaches are used on a regular basis. Gerlach and Smets (1999) explored an Multivariate Unobserved Components (MUC) model to estimate the output gap for the European Monetary Unit area and found that an increase in the output gap by one percentage point raises the inflation by 0.2 percent in the next quarter and an one percentage point increase in the real interest rate reduces next quarter output gap by approximately 0.1 per cent. The output gap was postulated as a function of its own lags and to a lagged real interest rate.

Clauss (2000) estimated potential output for the New Zealand economy through the Structural Vector Autoregression (SVAR) methodology, under the assumption of that demand-side disturbance have no long-run effect on output, while the productivity shocks are assumed to have a permanent effect on output and accordingly potential output is associated with the productivity shocks. Apart from the aggregate output, the rate of employment and capacity utilization were used to estimate the potential output under the SVAR framework.

Cerra and Saxena (2000) applied both UUC and MUC models to estimate the output gap for Sweden. In the multivariate case, inflation and unemployment both were applied separately to estimate the output gap. Scott (2000) estimated the output gap for the New Zealand economy using MUC model, by assuming a common output gap for Gross Domestic Product (GDP), unemployment rate and capacity utilization.

For Norway, Bjoruland *et al.* (2005) compared different univariate and multivariate methods to estimate the output gap. The models under the multivariate framework were found to have been superior to the univariate counterparts in estimating the output gap. The univariate methods include the HP filter; the BP filter and UUC model, while the multivariate methods include the MUC model and SVAR. Under the multivariate framework, unemployment rate and/ or inflation were incorporated as the other economic variables.

Llosa and Miller (2005) estimated the output gap for Peru based on the MUC model through a system of structural equations consisting of four variables, viz., an index of real monetary conditions, domestic inflation, imported inflation and inflation expectation. Sarikaya et al. (2005) estimated the potential output and output gap for the Turkish economy using MUC approach, through a semi structural model. The model consists of five equations, consisting of observable variables: inflation rate, real GDP, real effective exchange rate, real interest rate based on 3-month Treasury auction and a demand index, constructed from the Business Tendency Survey.

In the context of India, generally, the HP-filter is being widely applied to estimate the output gap for the industrial sector [Collen and Chang (1999), Ray and Chatterjee (2001)]. Donde and Saggar (1999) applied both HP- filter and UUC model to estimate the potential output for the industrial sector in India. They further applied the HP- filter to estimate the potential output for the Indian economy based on annual observation during 1950-51 to 2000-01.

Section IV
Empirical Estimation of Potential Output in India

Empirical estimates of potential output in India are worked out based on various approaches as indicated above. However, due to data limitations, particularly on employment, production function approach is not attempted. In addition, due to lack of conceptual clarity, estimates based on DSGE models are not worked out. Empirical estimates are presented separately using both monthly and quarterly data.

IV.1. Estimates of Potential Output for monthly IIP series

Estimates of potential output for the monthly series are obtained by using seven alternative methods, consisting of four univariate and three multivariate methods. The univariate methods consist of HP filter, BP filter, BN-decomposition and UUC methods, while the multivariate methods includes the MUC (based on MCI) and two SVAR estimates – based on WPI and MCI, respectively. The sample covers the period from April 1994 to December 2007. For HP-filter, the parameter used to smooth the data has been set at 14400, while for the BP-filter the estimates are obtained within the specified range between 15 to 60 months.

The estimates of potential growth rate, based on the alternative methodologies, are presented in Table 1. As can be observed from the table, the estimate of the potential growth rate for the Indian economy has been found to have varied in the range from 8.2 percent to 10.2 percent. However, the estimate of 8.2 percent, derived based on the MUC methodology, seems to be on the lower side compared to the alternative methodologies. The estimates of the potential growth rates, based on the HP-filter, BP-filter, UUC and the two SVAR methodologies are found to have converged, within the range 9.4 percent to 9.7 percent.

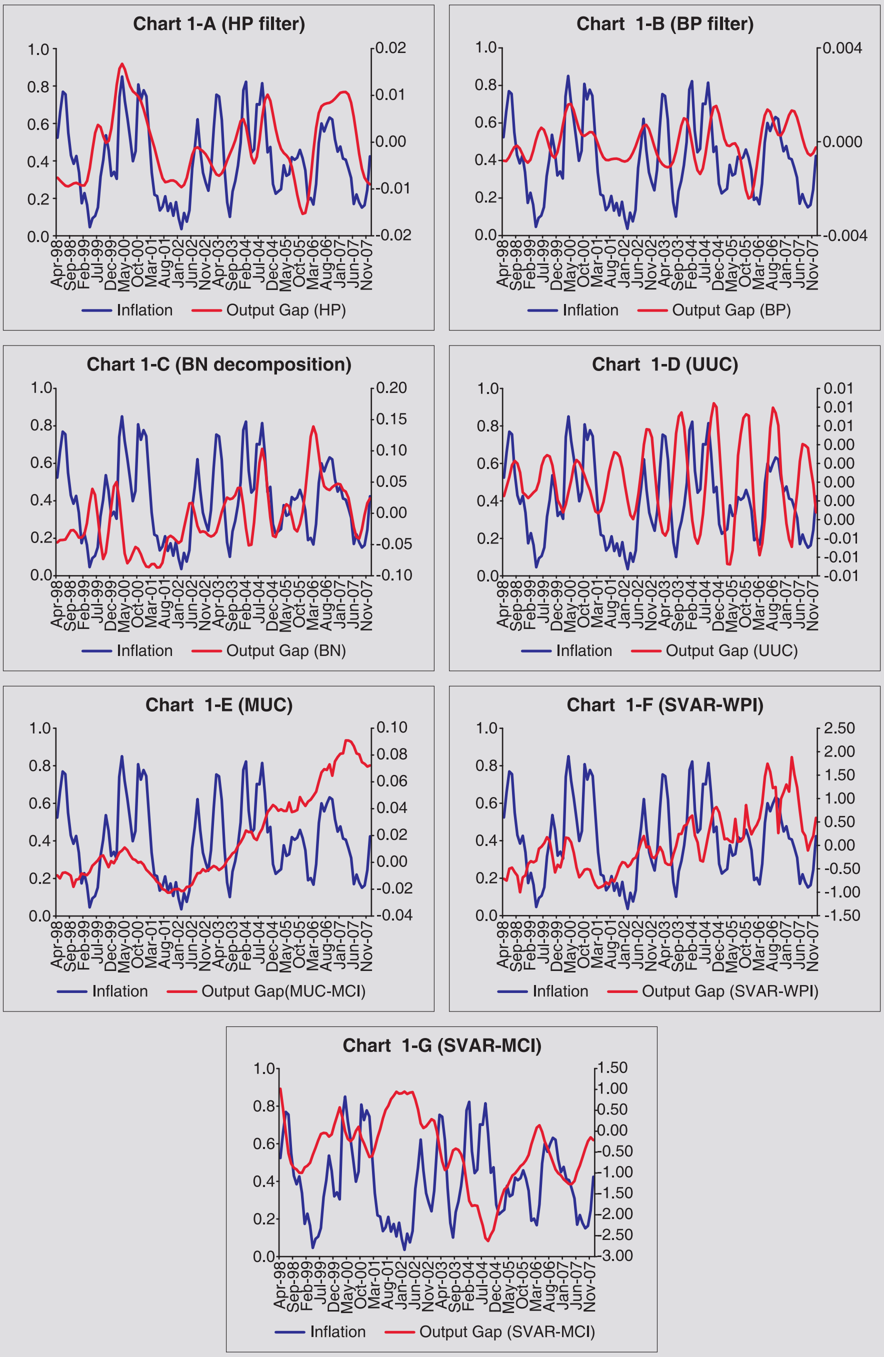
Table 1: Estimate of Potential Growth Rates based on monthly data

Methods	Potential Growth Rate
HP	9.5
BP	9.4
BN	10.2
UUC	9.7
MUC	8.2
SVAR - WPI	9.4
SVAR - MCI	9.5

IV.2. Estimates of Potential Output for quarterly GDP series

Estimates of potential output for the quarterly series are obtained by using eight alternative methods, consisting of four univariate and four multivariate methods. Apart from using the same set of univariate and multivariate methods, used to estimate the potential output for the monthly data, one alternative method of MUC has been used. The

Chart-1: Plot of Inflation Rate (month-over-month) and estimates of Output Gap



two alternative methods of MUC are based on MCI and Capacity Utilization (CU), where the estimate of CU is based on the survey conducted by the National Council of Applied Economic Research (NCAER), New Delhi. The sample covers the period from the first quarter (April- June) of the financial year 1996-97 to third quarter (October – December) of the financial year 2007-08. For HP-filter, the parameter used to smooth the data has been set at 1600, while for the BP-filter the estimates are obtained within the specified range between 5 to 24 quarters.

Table 2: Estimate of Potential Growth Rates based on quarterly data

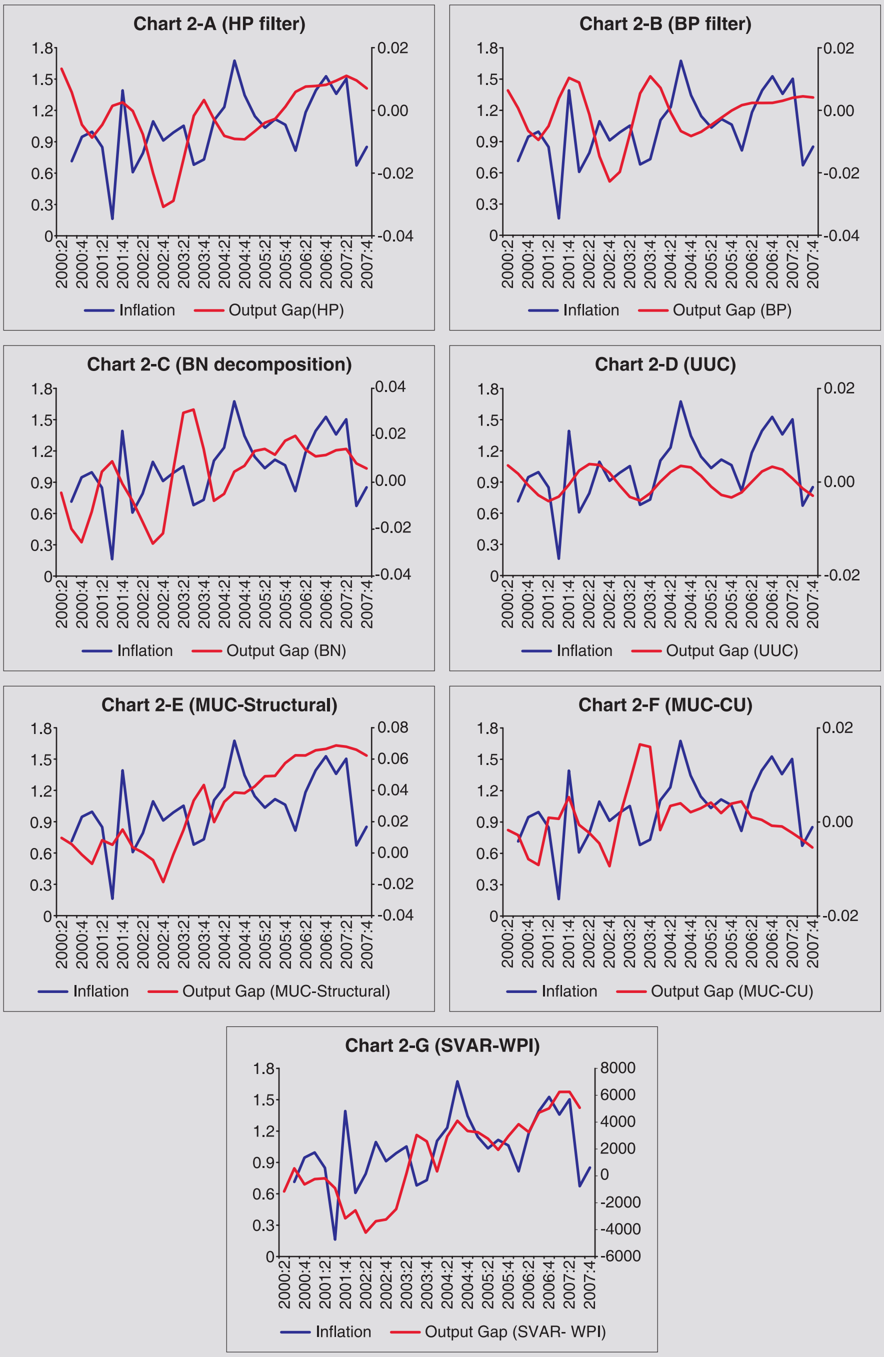
Methods	Potential Growth Rate
HP	8.5
BP	8.9
BN	9.0
UUC	9.2
MUC - Structural	8.1
MUC - CU	9.5
SVAR - WPI	9.0
SVAR - MCI	9.2

The estimates of potential growth rate, based on the eight alternative methodologies, are presented in Table 2. As can be observed from the table, the estimate of the potential growth rate for the Indian economy, based on the GDP, has been found to have varied in the range from 8.1 percent to 9.5 percent. The estimates of the potential growth rates, based on the BP-filter, BN decomposition, UUC and the two SVAR methodologies are found to have concentrated near 9.0 percent.

IV.3. Selection of the method of estimation of output gap

As mentioned earlier, selection of the method to estimate output gap can be done by either spectral analysis or regression analysis. In the regression analysis, one can fit a regression equation and assess the out-of-sample forecasting performance of the equation based on certain statistical criteria, like Mean Square Error (MSE), Root Mean

Chart-2: Plot of Inflation Rate (quarter-over-quarter) and estimates of Output Gap



Square Error (RMSE), $\bar{R}^2$ etc. The equation, corresponding to the estimate of output gap, having minimum MSE or RMSE or maximum $\bar{R}^2$ may be selected to estimate the potential output. In the spectral analysis, the method that explains the larger proportion of spectral mass in the range of business cycle frequencies (i.e. from 5-quarters to 32-quarters or 15-months to 96-months) may be selected for estimation of the potential output.

IV.3.1. Selection of the estimate of output gap by regression analysis

To assess the ability and significance of the relationship between inflation and the estimated output gap, the following equation has been estimated, as proposed by Coe and McDermott (1997). Inflation, used in the equation, is measured by the changes in the price level over the previous period as compared to the same period last year. This measure of inflation helps in assessing the impact of the demand conditions, reflected through the output gap, on inflation. For the monthly series, WPI is used to measure the inflation, while GDP deflator is used to measure the quarterly inflation. Before empirical analysis, both the WPI and GDP are seasonally adjusted using the X-12-ARIMA technique.

$$inflation_t = c + \sum_{i=0}^{m} \beta_i \Delta z_{t-i} + \sum_{i=0}^{n} \gamma_i \, inflation_{t-i} + \varepsilon_{1t} \qquad (7)$$

where *inflation* denotes the inflation rate estimated based on the monthly WPI or quarterly GDP series. The constant term 'c' included in the equation, indicates the contribution of the non-inflationary level of the output gap. The lag length 'm' is determined by the Akaike's Information Criterion (AIC).

IV.3.2. Selection of the method for estimation of monthly output gap

For selection of the method to estimate output gap by regression analysis, we divide the full sample period into two sub-samples. The first sample, known as the in-sample, covering the period from April 1994 to June 2006, is used to estimate the parameters of the equation, while the second-sample, known as the out-of-sample, covering the period from July 2006 to December 2007, is used to assess the forecasting ability of the output gap estimates through RMSE and $\bar{R}^2$.

Table 3 presents the out-of-sample RMSE of the alternative equations based on the estimates of output gap by different methodologies. From the table, it can be observed that, based on the HP-filter estimate of output gap, the RMSE is found to be least at 0.542, while $\bar{R}$ is found to be maximum at 0.89. Thus regression analysis prefers the application of HP-filter to estimate the potential output in the monthly IIP series.

Table 3: Estimate of the equation based on monthly data

Methods	$\bar{R}^2$	RMSE
HP	0.89	0.542
BP	0.88	0.565
BN	0.88	0.569
UUC	0.86	0.611
MUC	0.88	0.561
SVAR - WPI	0.88	0.578
SVAR - MCI	0.86	0.609

Table 4 presents the percentages of the spectral mass lying within the defined range of business cycle of the alternative methods. Data covers the period from April 1994 to December 2007. As can be observed from the table, the UUC method, which explains 98.1 per cent within the business cycle frequency, is the most proficient at isolating output gap in the monthly industrial production at the

Table 4: Percentage of Spectral mass within the business cycle frequency

Methods	Percentage
HP	91.7
BP	95.3
BN	69.3
UUC	98.1
MUC	66.9
SVAR - WPI	49.0
SVAR - MCI	46.9

medium term. The BP filter is also relatively proficient, which explains 95.3 per cent of the total variation. This suggests the selection of UUC method to estimate the potential output in the monthly IIP series.

IV.3.3. Selection of the method for estimation of quarterly output gap

For selection of the method to estimate quarterly output gap by regression analysis, we divide the full sample period into in-sample and out-of-sample, as defined above. The in-sample covers the period from 1996-97:Q1 to 2004-05:Q4, while the out-of-sample covers the period from 2005-06:Q1 to 2007-08:Q3. The forecasting ability of the output gap estimates are assessed through out-of-sample RMSE and $\bar{R}^2$.

Table 5 presents the out-of-sample RMSE of the alternative equations based on the estimates of output gap by different methodologies. From the table it can be observed that, the RMSE is found to be least in case of UUC, while $\bar{R}^2$ is found to be marginally higher in HP compared to UUC. Thus the UUC method can be used to estimate the potential output in the quarterly GDP series. As the RMSE of HP is found to be the second least and thus one can apply HP-filter also to estimate the quarterly potential output.

Table 5: Estimate of the equation based on quarterly data

Methods	$\bar{R}^2$	RMSE
HP	0.31	1.083
BP	0.13	1.202
BN	0.18	1.151
UUC	0.30	1.067
MUC - Structural	0.22	1.113
MUC - CU	0.15	1.178
SVAR - WPI	0.05	1.225
SVAR - MCI	0.06	1.218

Table 6 presents the percentages of the spectral mass lying within the business cycle frequency range of the alternative methods. The sample covers the period from 1996-97:Q1 to 2007-08:Q3. It can be observed from the table that both UUC and MUC- Structural methods,

Table 6: Percentage of Spectral mass within the business cycle frequency

Methods	Percentage
HP	98.7
BP	99.6
BN	94.6
UUC	99.7
MUC - Structural	99.7
MUC - CU	84.0
SVAR - WPI	97.3
SVAR - MCI	32.7

which explains 99.7 per cent within the business cycle frequency, are the most proficient methods to estimate the output gap in the quarterly GDP. The BP filter is also relatively proficient explaining 99.6 per cent of the total variation. This criterion of selection of the method to estimate output gap suggests UUC or MUC- Structural method as the most proficient methods for estimation of potential output in the quarterly GDP.

Section V
Conclusion

As an economic concept, the definition of potential output is not unambiguous. The idea of potential output is essential not to capture the output, but the process of inflation dynamics in the economy. No statistical measure, however sophisticated, is available which could reasonably capture the overall demand of the economy, except potential output. The crux of modern monetary policy making lies with the understanding of demand process and thus the concept of potential output is critically important. The path of the maximum sustainable level indicates that level of output that is consistent with stable price level. In other words, potential output is the maximum output an economy could produce without putting pressure on price level. That is potential output is that level of output at which the aggregate demand and supply in the economy are balanced, so that, inflation tends to its long-run expected value, if other factors remains constant. Output gap, which is the discrepancy between the actual output and the potential output, indicates the presence of disequilibrium in the economy. When the actual output exceeds the potential output, i.e. the output gap becomes positive, the rising demand leads to an increase in the price level, if temporary supply factors are held constant. In case of a negative output gap, inflation tends to fall.

In this paper, empirical estimates of potential output in India are presented using several advanced econometric methods. The selection of an appropriate method to estimate output gap is done by either spectral analysis or regression analysis. While in the regression analysis, the out-of-sample forecasting performance of the regression equation of potential output explaining inflation is used, in the spectral analysis, the method that explains the larger proportion of spectral mass in the range of business cycle frequencies (i.e. from 5-quarters to 32-quarters or 15-months to 96-months) is used.

For monthly data, the estimate of the potential growth rate for the Indian economy is found to vary in the range from 8.2 percent to 10.2 percent. The estimates of the potential growth rates, based on the HP-filter, BP-filter, UUC model and the two SVAR methodologies converge within the range from 9.4 percent to 9.7 percent. For quarterly data, the estimates of the potential growth rate for the Indian economy vary in the range from 8.1 percent to 9.5 percent and methods like BP-filter, BN decomposition, UUC model and the two SVAR methodologies produce potential output consistently near 9.0 percent. The diagnostics of the empirical methodologies suggest that UUC or MUC- structural method are most efficient methods for estimation of quarterly potential output.

Notes

[1] We follow custom in referring stationary, transitory deviation from trend as the 'cycle' even if it is not periodic.

[2] Beveridge-Nelson decomposition assumes a perfect negative correlation between shocks to the trend and cycle, whereas Unobserved Components model assumes the shocks to trend and cycle are uncorrelated.

[3] See Annexure-I for description of MCI and construction of MCI in India.

[4] This is against the unrestricted VAR methodology, where the effects of shocks on all variables are left unconstrained at all horizons.

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Annexure-I

Monetary Condition Index

Monetary Condition Index (MCI) is weighted average of changes in an interest rate and exchange rate relative to their values in a base period. The weights on the interest rate and exchange rate measure the relative effects of these variables on the target variables like aggregate demand or inflation over some period. The extent of monetary tightening or loosening compared to a previous period may be judged by observing at the two principal channels of transmission process – the interest rates and the exchange rates. MCI are computed to infer the extent of internal and external influences on the overall monetary conditions of a country. Algebraically, an MCI is written as,

$$MCI_t = \theta_r(r_t - r_0) + \theta_e(e_t - e_0)$$

where r and e represents the interest rates and exchange rates, and θ_e and θ_r are the corresponding weights, respectively. An increase in the MCI, which may occur due to an increase in the interest rates or exchange rates, leads to fall in the aggregate demand or inflation. Thus an increase in MCI, lowers both aggregate demand and price level and it reflects monetary tightening.

Estimation of MCI weights:

Generally, the weights used to compile MCI are derived based on four alternative methodologies and are described as follows:

(a) Single Equation based:

The relative weights that measure the relative impact of interest and exchange rates on aggregate demand can be derived directly by estimating an aggregate demand equation. The Deutsche Bank derives the weights from an aggregate demand equation.

(b) Model based:

Weights may also be estimated based on prior estimates of aggregate demand equations of existing models. The OECD bases the weights on the MCI from its Interlink Model.

(c) Trade share based:

Weights may also be derived based on the exchange rate variable as a function of the long-run export to GDP ratio. The interest rate weight is then calculated as one minus the exchange rate weight. The weights are interpreted as a crude relative measure of the effect of the exchange rate on GDP *vis-à-vis* the interest rate effect on GDP. J.P. Morgan constructs a real MCI for the UK based on this methodology.

(d) Multiple equation based:

The weights for the MCI may also be derived based on unrestricted vector autoregression methodology. MCI weights are obtained based on the impulse response function of aggregate output to a shock to each of the interest rate and exchange rate. Generally, weights are based on the cumulative average responsiveness to the shocks till the responses die out. If the variables are found to possess long-run equilibrium relationship, the weights can be derived based on the impulse response function under the cointegration framework (Batini and Turnbull, 2002).

Construction of MCI for India

For the Indian economy, not much work has been done to construct MCI. Kannan *et al* (2006) constructed two MCI for the Indian economy. The first MCI, defined as *narrow MCI*, was constructed based on interest rate and exchange rate, while the second MCI, defined as *broad MCI,* was constructed by incorporating credit growth along with the two rates. The weights were derived based on the single equation estimates of the coefficients of the variables on the overall gross domestic product (GDP) excluding the agriculture & allied activities and the community, personal and social services.

For our empirical analysis, the MCI is constructed based on the broad definition as defined in Kannan *op cit.* The form of the MCI is as follows,

$$MCI_t = \theta_r(r_t - r_0) + \theta_e(e_t - e_0) + \theta_c(c_t - c_0)$$

As the multiplication of MCI by a constant does not make any difference in the index, the MCI can be expressed in terms of the ratios,

$$MCI_t = (r_t - r_0) + (\theta_e / \theta_r)(e_t - e_0) + (\theta_c / \theta_r)(c_t - c_0)$$

The ratios θ_e / θ_r and θ_c / θ_r are critical in computing MCI, while the first ratio indicates the relative importance of exchange rate vis-à-vis the interest rate, the second ratio indicates the relative importance of credit growth vis-à-vis the interest rate.

The weights in the MCI are derived based on the multiple equation methodology. The interest rate is represented by the average of the weighted call money rate (CMR), while exchange rate is represented by the 36-country trade based effective exchange rate of the Indian Rupee (either nominal (NEER36) or real (REER36)) and non-food credit (NFC) growth. Both the NEER36 and REER36 are adjusted by deviation from it base value of 100.

(a) Monthly MCI

For deriving the weights of the monthly MCI, initially, the variables were tested for order of integration. The widely applied Augmented Dickey-Fuller (ADF) test was applied to determine the order of integration. Due to lack of monthly GDP, the Index of Industrial Production (IIP) is used to represent the output. Empirical results related to the ADF test are presented in Table A1. From the table, it can be observed that the annual point-to-point growth in IIP, CMR and NEER36 are I(0), while, annual point-to-point growth in NFC is I(1). The sample covers the period from April 1994 to December 2007.

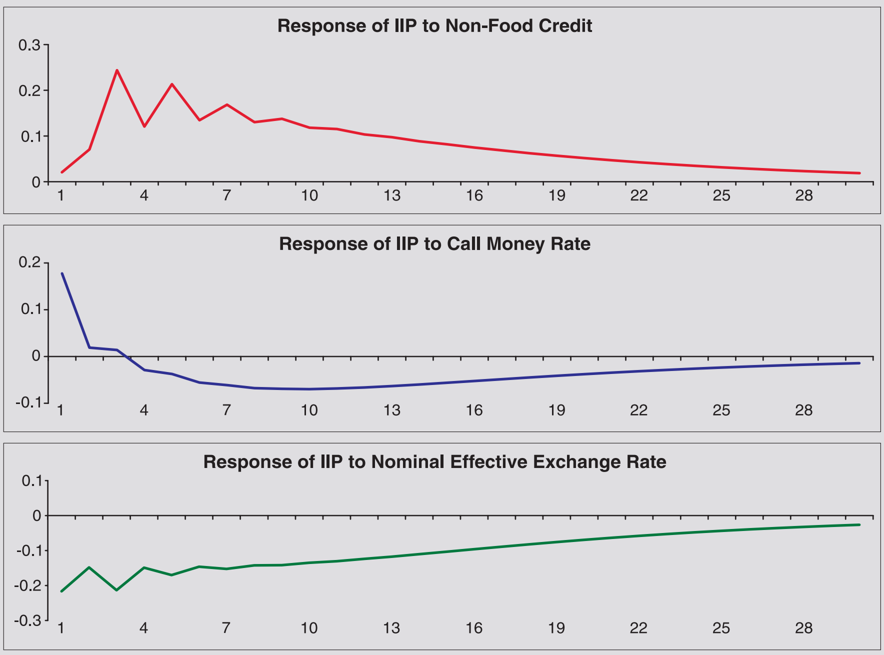
Table A1: Augmented Dickey-Fuller Unit Root Test

	At level			At first difference			Remark
	Test Statistic	Critical Value	Form of the ADF regression	Test Statistic	Critical Value	Form of the ADF regression	
IIP_g	-3.095 (0.029)	-2.881	Constant	---	---	---	I(0)
CMR	-7.739 (0.000)	-3.437	Constant, Linear Trend	---	---	---	I(0)
NEER36	-3.832 (0.003)	-3.437	Constant	---	---	---	I(0)
NFC_g	-0.616 (0.449)	-1.943	None	-13.940 (0.000)	-1.943	None	I(1)

Note: Figures in the parentheses indicate the p-values corresponding to the null hypothesis of existence of unit roots.

To derive the weights for the MCI, we applied the method of unrestricted vector autoregression using the variables IIP_g, CMR, NEER36 and the first difference of NFC_g. The impulse responses of IIP_g to shock of each of the other variables are found to have died after a period of 30-months. The following graphs present the impulse response function of IIP_g to the other variables.

Chart-A1: Response of IIP to Cholesky one standard deviation Innovations



The weights for the MCI are derived as the cumulative average responsiveness to the shocks till 30-months.

Based on the above analysis, the MCI can be represented as,

$$MCI_t = (r_t - r_0) + 3.198(e_t - e_0) - 2.597(c_t - c_0)$$

(b) Quarterly MCI

For deriving the weights of the quarterly MCI, initially, the variables were tested for order of integration using ADF. The quarterly non-agricultural GDP (NAGDP) is used to represent the output. Empirical results related to the ADF test are presented in Table A-2. From Table A2, it can be observed that the annual point-to-point growth in NAGDP and NFC, CMR (adjusted for inflation) and REER36 are I(0), while, NEER36 is I(1). The sample covers the period from 1993-94:Q1 to 2007-08:Q3.

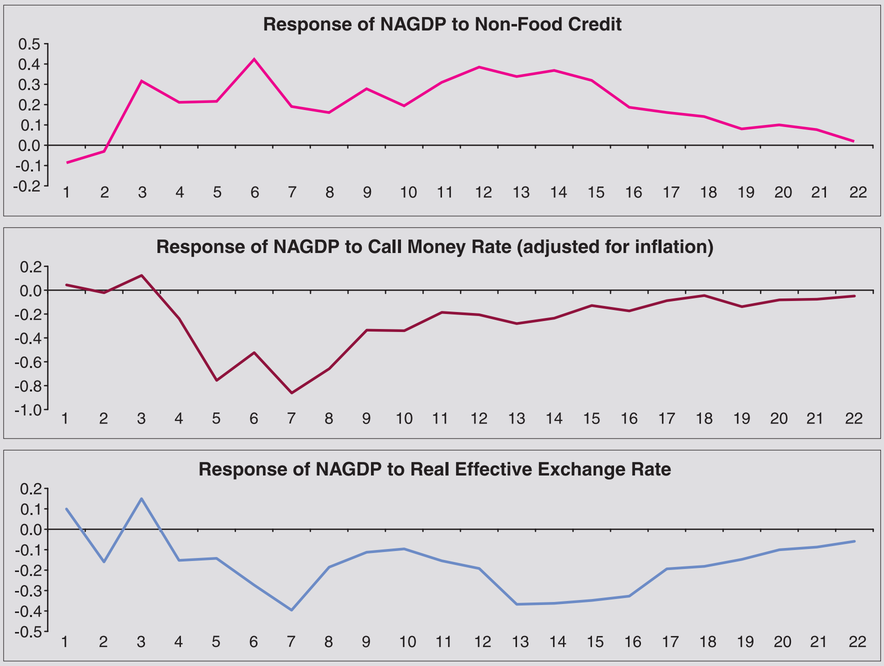
To derive the weights for the MCI, we applied the method of unrestricted vector autoregression using the variables NAGDP_g, CMR, NFC_g, REER36 and the first difference of NEER36. The impulse responses of NAGDP_g to shock of each of the other variables, *viz.* CMR, NFC_g and REER36 are found to have died

Table A2: Augmented Dickey-Fuller Unit Root Test

	At level			At first difference			Remark
	Test Statistic	Critical Value	Form of the ADF regression	Test Statistic	Critical Value	Form of the ADF regression	
NAGDP_g	-3.152 (0.028)	-2.913	Constant	---	---	---	I(0)
CMR	-3.237 (0.002)	-1.946	None	---	---	---	I(0)
NEER36	-2.358 (0.158)	-2.913	Constant	-7.521 (0.000)	-1.947	None	I(1)
REER36	-2.322 (0.021)	-1.946	None	---	---	---	I(0)
NFC_g	-4.656 (0.002)	-3.488	Constant, Linear Trend	---	---	---	I(0)

Note: Figures in the parentheses indicate the p-values corresponding to the null hypothesis of existence of unit roots.

Chart-A2: Response of NAGDP to Cholesky one standard deviation Innovations



after a period of 22-quarters. The following graphs present the impulse response function of NAGDP_g to the other variables.

The weights for the MCI are derived as the cumulative average responsiveness to the shocks till 22-quarters.

Based on the above analysis, the MCI can be represented as,

$$MCI_t = (r_t - r_0) + 0.721(e_t - e_0) - 0.830(c_t - c_0)$$

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Impact of Agricultural Credit on Agriculture Production: An Empirical Analysis in India

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Available data suggest that agricultural credit has been rising in recent years as a share of both the value of inputs and the value of output. There are wide regional disparities in the disbursement of agricultural credit by scheduled commercial banks. At the same time the share of agricultural GDP in total GDP is falling. In this context, this paper examines the role of direct and indirect agriculture credit in the agriculture production taking care of the regional disparities in agriculture, credit disbursement and agriculture production in an econometric framework using Dynamic Panel Data Analysis with Instrumental Variables using Arellano-Bond Regression. The analysis suggests that the direct agriculture credit amount has a positive and statistically significant impact on agriculture output and its effect is immediate. The number of accounts of the indirect agriculture credit also has a positive significant impact on agriculture output, but with a year lag. These results reveal that even though there are several gaps in the present institutional credit delivery system like inadequate provision of credit to small and marginal farmers, paucity of medium and long-term lending and limited deposit mobilisation and heavy dependence on borrowed funds by major agricultural credit purveyors, agriculture credit is still playing a critical role in supporting agriculture production in India.

JEL Classification : **Q14, C23**

Keywords : Agriculture Credit, Panel Data, Generalised Method of Moments

Introduction

A large proportion of the population in India is rural based and depends on agriculture for a living. Enhanced and stable growth of the agriculture sector is important as it plays a vital role not only in generating purchasing power among the rural population by creating

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on-farm and off-farm employment opportunities but also through its contribution to price stability. In India, although the share of agriculture in real GDP has declined below one-fifth, it continues to be an important sector as it employs 52 per cent of the workforce. The growing adult population in India demand large and incessant rise in agricultural production. But per capita availability of food, particularly cereals and pulses, in recent years has fallen significantly. As a result, slackening growth of agriculture during last decade has been a major policy concern.

Three main factors that contribute to agricultural growth are increased use of agricultural inputs, technological change and technical efficiency. With savings being negligible among the small farmers, agricultural credit appears to be an essential input along with modern technology for higher productivity. An important aspect that has emerged in last three decades is that the credit is not only obtained by the small and marginal farmers for survival but also by the large farmers for enhancing their income. Hence, since independence, credit has been occupying an important place in the strategy for development of agriculture. The agricultural credit system of India consists of informal and formal sources of credit supply. The informal sources include friends, relatives, commission agents, traders, private moneylenders, etc. Three major channels for disbursement of formal credit include commercial banks, cooperatives and micro-finance institutions (MFI) covering the whole length and breadth of the country. The overall thrust of the current policy regime assumes that credit is a critical input that affects agricultural/ rural productivity and is important enough to establish causality with productivity. Therefore, impulses in the agricultural operations are sought through intervention in credit.

In order to improve the flow of credit to the agricultural sector, the Reserve Bank had advised public sector banks to prepare Special Agricultural Credit Plans (SACP) in 1994-95. Under the SACP, the banks are required to fix self-set targets for achievement during the year (April-March). The targets are generally fixed by the banks about 20 to 25 per cent higher over the disbursements made in the previous year. With the introduction of SACP, the flow of credit to agricultural sector has increased significantly from Rs.8,255 crore in 1994-95 to Rs.1,22,443 crore in 2006-07 which were higher than the projection of Rs.1,18,160 crore. As against the target of Rs.1,52,133 crore for the financial year 2007-08, disbursements to agriculture by public sector banks under the plan were Rs.1,11,543 crore (provisional). As recommended by the Advisory Committee on Flow of Credit to Agriculture and Related Activities from the Banking System (Chairman: Shri V.S. Vyas), the Mid-Term Review of Annual Policy of RBI for 2004-05 made the SACP mechanism applicable to private sector banks from the year 2005-06. Disbursements to agriculture by private sector banks under SACP during 2006-07 aggregated to Rs.44, 093 crore against the target of Rs.40,656 crore. As against the target of Rs.41,427 crore for the financial year 2007-08, disbursements to agriculture by private sector banks aggregated to Rs.45,905 crore (provisional).

From the Government side, with a view to doubling credit flow to agriculture within a period of three years and to provide some relief to farmers affected by natural calamities within the limits of financial prudence, the Union Finance Minister announced several measures on June 18, 2004. Accordingly, the Reserve Bank and NABARD issued necessary operational guidelines to banks. From the very beginning, the actual disbursements exceeded the targets for each of the last four years. As against the target of Rs.2,25,000 crore for 2007-08, all banks disbursed Rs.2,25,348 crore (provisional). During 2007-08, 7.29 million new farmers were financed by commercial banks and RRBs as against the target of 5 million farmers fixed by the Union Finance Minister for the year. The Finance Minister, in his Budget Speech for the year 2008-09, urged the banks to increase the level of credit to Rs.2,80,000 crore during the year 2008-09.

Such efforts have, however, not been transmitted to the growth in agriculture output. Since the mid-1990s, the growth of the agricultural sector has been low as well as volatile; the growth decelerated from an annual average of 4.7 per cent per annum during 1980s to 3.1 per cent during the 1990s and further to 2.2 per cent during the Tenth Plan period. Growth in agricultural production has decelerated during 2006-07 with the agriculture sector characterised by stagnation in output of major food grains. Per capita annual production of cereals declined from 192 kilogram (kg) during 1991-95 to 174 kg during 2004-07 and that of pulses from 15 kg to 12 kg over the same period. Per capita availability of food grains has, thus, fallen close to the levels prevailing during the 1970s.

Volatility in agricultural production has not only affected overall growth but also exerted persistence pressure on maintaining low and stable inflation. Demand-supply gaps were reflected in higher domestic food prices in recent years. All these evidences apparently point to the fact that higher credit to agriculture is not translated into commensurate increase in agricultural output. In this paper, we examine this basic premise empirically using both macro- and micro level data.

The rest of the paper is organized as follows. Section I presents a brief review of recent literature on the broader issue of bank credit and agriculture output. Section II makes an assessment of progress in agriculture credit in India. Econometric methodology of dynamic panel data regression, including some description on the economic framework of the proposed model is given in Section III. Section IV presents the empirical results. Concluding remarks follow in Section V.

Section I. Literature Review

India has systematically pursued a supply leading approach to increase agricultural credit. The objectives have been to replace moneylenders, relieve farmers of indebtedness and to achieve higher levels of agricultural credit, investment and agricultural output. Among earlier studies, Binswanger and Khandker (1992) found that the output and employment effect of expanded rural finance has been much smaller than in the nonfarm sector. The effect on crop output is not large, despite the fact that credit to agriculture has strongly increased fertilizer use and private investment in machines and livestock. High impact on inputs and modest impact on output clearly mean that the additional capital investment has been more important in substituting for agricultural labor than in increasing crop output.

Between bank nationalization in 1969 and the onset of financial liberalization in 1990 bank branches were opened in over 30,000 rural locations which had no prior presence of commercial banks (called un-banked locations). Alongside, the share of bank credit and savings which was accounted for by rural branches raised from 1.5 and 3 percent respectively to 15 percent each (Burgess and Pande, 2005). This branch expansion was an integral part of India's social banking experiment which sought to improve the access of the rural poor to cheap formal credit. The estimates suggested that a one percent increase in the number of rural banked locations reduced rural poverty by roughly 0.4 percent and increased total output by 0.30 percent. The output effects are solely accounted for by increases in non-agricultural output – a finding which suggests that increased financial intermediation in rural India aided output and employment diversification out of agriculture.

In a detailed paper, Mohan (2006) examined the overall growth of agriculture and the role of institutional credit. Agreeing that the overall supply of credit to agriculture as a percentage of total disbursal of credit is going down, he argued that this should not be a cause for worry as the share of formal credit as a part of the agricultural GDP is growing. This establishes that while credit is increasing, it has not really made an impact on value of output figures which points out the limitations of credit. In another study, Golait (2007) attempted to analyse the issues in agricultural credit in India. The analysis revealed that the credit delivery to the agriculture sector continues to be inadequate. It appeared that the banking system is still hesitant on various grounds to purvey credit to small and marginal farmers. It was suggested that concerted efforts were required to augment the flow of credit to agriculture, alongside exploring new innovations in product design and methods of delivery, through better use of technology and related processes. Facilitating credit through processors, input dealers, NGOs, etc., that were vertically integrated with the farmers, including through contract farming, for providing them critical inputs or processing their produce, could increase the credit flow to agriculture significantly.

In general, it is difficult to establish a causal relationship between agriculture credit and production due to the existence of critical endogeneity problem. However, Sreeram (2007) concluded that increased supply and administered pricing of credit help in the increase in agricultural productivity and the well being of agriculturists as credit is a sub-component of the total investments made in agriculture. Borrowings could in fact be from multiple sources in the formal and informal space. Borrowing from formal sources is a part of this sub-component. With data being available largely from the formal sources of credit disbursal and indications that the formal credit as a proportion of total indebtedness is going down, it becomes much more difficult to establish the causality. He also stated that the diversity in cropping patterns, holding sizes, productivity, regional variations make it difficult to establish such a causality for agriculture or rural sector as a whole, even if one had data. Finally, he argued that mere increase in supply of credit is not going to address the problem of productivity, unless it is accompanied by investments in other support services. In the present study, we take a re-look at the problem by quantitatively assessing the impact of institutional credit expansion on agriculture.

Section II. Assessment of Progress in Agricultural Credit in India

In India, the share of agriculture in the gross domestic product has registered a steady decline from 36.4 per cent in 1982-83 to 18.5 per cent in 2006-07. Agriculture growth has remained lower than the growth rates witnessed in the industrial and services sectors. The gap between the growth of agriculture and non-agriculture sector began to widen since 1981-82, and more particularly since 1996-97, because of acceleration in the growth of industry and services sectors (Table 1). Even though the share of agriculture in GDP has declined over the years, the number of people dependent on agriculture for their food and livelihood has remained unchanged. Therefore, a number of measures were taken by the Reserve Bank and the Government of India for facilitating increased credit flows to the agriculture sector. With a view to doubling credit flow to agriculture within a period of three years, several measures have been announced. From the very beginning, the actual disbursements exceeded the targets for each of the last four years (Table 2).

Table 1: Average GDP growth rates of agriculture and other sectors at 1999-2000 prices

(Per cent)

Period		Total Economy	Agriculture & allied	Crops & livestock	Non-agriculture
1	2	3	4	5	6
Pre-Green Revolution	1951-52 to 1967-68	3.7	2.5	2.7	4.9
Green Revolution period	1968-69 to 1980-81	3.5	2.4	2.7	4.4
Wider technology dissemination period	1981-82-1990-91	5.4	3.5	3.7	6.4
Early Reform Period	1991-92 to 1996-97	5.7	3.7	3.7	6.6
Ninth and Tenth Plan	1997-98 to 2006-07	6.6	2.5	2.5	7.9
	2005-06 to 2006-07	9.5	4.8	5.0	10.7

Source: Economic Survey (2007-08).

The increased credit flow to agriculture has not resulted in the commensurate increase in production. The average rate of growth of foodgrains production decelerated to 1.2 per cent during 1990-2007, lower than annual rate of growth of population, averaging 1.9 per cent. The per capita availability of cereals and pulses has witnessed a decline during this period. The consumption of cereals declined from a peak of 468 grams per capita per day in 1990-91 to 412 grams per capita per day in 2005-06, indicating a decline of 13 per cent during this period. The

Table 2: Targets and actual disbursement to agriculture by banks

(Rs. crore)

Agency	(2004-05)		(2005-06)		(2006-07)		(2007-08)*	
	Target	Disbursement	Target	Disbursement	Target	Disbursement	Target	Disbursement
1	2	3	4	5	6	7	8	9
Comm. Banks	57,000	81,481	87,200	1,25,477	1,19,000	16,64,486	1,50,000	1,56,850
Coop. Banks	39,000	31,231	38,600	39,786	41,000	42,480	52,000	43,684
RRBs	8,500	12,404	15,200	15,223	15,000	20,435	23,000	24,814
Other Agencies		193						
Total	**1,05,000**	**1,25,309**	**1,41,000**	**1,80,486**	**1,75,000**	**2,29,401**	**2,25,000**	**2,25,348**

Source: NABARD; *: Provisional; RRBs:Regional Rural Banks.

consumption of pulses declined from 42 grams per capita per day (72 grams in 1956-57) to 33 grams per capita per day during the same period. The overall production of food grains was estimated at 217.3 million tonnes in 2006-07, an increase of 4.2 per cent over 2005-06. Compared to the target set for 2006-07, it was, however, lower by 2.7 million tonnes (1.2 per cent). Over a medium term, there has generally been a shortfall in the achievement of target of foodgrains, pulses and oilseeds during 2000-01 to 2006-07. The actual production of foodgrains on an average was 93 per cent of the target (Table 3). Actual production, however, was only 87.7 per cent of target for pulses and 85.3 per cent of target for oilseeds.

The production of agriculture crops, besides the weather-induced fluctuations, significantly depends on the availability of inputs like fertilizers, irrigation, certified seeds, credit support and appropriate price signals. Minimum support prices indicated upfront and before the sowing seasons act as effective incentives for acreage response of the agricultural crops. Deviations in foodgrains and agricultural output from their long-term trends are determined, among other factors, by variations in monsoon around its long-term trend and the area under irrigation.

Table 3: Actual production relative to targets

(Per cent)

Crop	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**Average (2001-07)**
1	2	3	4	5	6	7	8
Rice	101.5	77.2	95.2	88.9	104.5	100.6	94.7
Wheat	93.3	84.3	92.5	86.3	91.8	100.4	91.4
Coarse cereals	101.1	79	110.6	90.9	93.3	92.9	94.6
Pulses	89.1	69.6	99.4	85.8	88.4	93.7	87.7
Foodgrains	**97.6**	**79.4**	**96.9**	**88.1**	**97**	**98.8**	**93**
Oilseeds	**37.8**	**55**	**102**	**93**	**105.2**	**82.6**	**85.3**
Sugarcane	91.4	89.8	73.1	87.8	118.4	131.7	98.7
Cotton	68.9	57.5	91.5	109.5	112.1	122.3	93.7
Jute & Mesta	106.2	94	93.1	87.1	96.1	99.9	96.1

Source: Economic Survey (2007-08).

Table 4: Rate of growth of production for major crops

(Per cent)

Year	Rice	Wheat	Pulses	Food grains	Cotton	Oilseeds	Sugarcane
1	2	3	4	5	6	7	8
1989-90 to 2006-07	1.17	1.9	-0.03	1.18	2.04	1.25	1.13
1992-93 to 1996-97	1.73	3.6	0.66	1.88	4.88	3.57	3.74
1997-98 to 2001-02	1.13	1.26	-2.52	0.67	5.79	-4.68	1.23
2002-03 to 2005-06	1.75	0.42	3.27	1.61	20.22	9.81	-1.23

Source: Economic Survey (2007-08).

On the productivity front, India is not only low relative to other countries in crop production, there are considerable inter-state variations. The productivity of wheat in 2005-06 varied from a low of 1,393 kg per ha in Maharashtra to a high of 4,179 kg in Punjab. The Steering Committee on Agriculture for the Eleventh Five Year Plan has observed that not only the yields differed across the States, there was a significant gap between the performance and potential as revealed by actual yield and yield with improved practices adopted by farmers (Table 5).

Table 5: Interstate Variation in Actual yield and yield with improved practices

State	Improved practice(I)	Farmer practice(F)	Actual yield 2003-04(A)	Gap (per cent)	
				I and F	I and A
1	2	3	4	5	6
Wheat (Yield : Kg/ha – 2002-03 to 2004-05)					
Bihar	3651	2905	1783	25.7	104.8
Madhya Pradesh	3297	2472	1789	33.4	84.3
Uttar Pradesh	4206	3324	2794	26.5	50.5
Rice (irrigated) (Yield : Kg/ha - 2003-04 to 2004-05)					
Uttar Pradesh	7050	5200	2187	35.6	222.4
Bihar	4883	4158	1516	17.4	222.1
Chhattisgarh	3919	3137	1455	24.9	169.4
Sugarcane					
Maharashtra	127440	99520	51297	28.1	148.4
Karnataka	147390	128000	66667	15.1	121.2
Bihar	74420	49440	40990	50.5	81.6

Source: Economic Survey (2007-08).

The above mentioned facts clearly underline the need to analyze the effect of institutionalized agriculture credit on agriculture output in an econometric framework. Considering the diverse nature of agriculture activities and agriculture credit distribution across the country, the Arellano-Bond (1991) dynamic panel estimation at district level is most suitable as it is designed for situations with 1) "small T, large N" panels, meaning few time periods and many individuals; 2) a linear functional relationship; 3) a single left-hand-side variable that is dynamic, depending on its own past realizations; 4) independent variables that are not strictly exogenous, meaning correlated with past and possibly current realizations of the error; 5) fixed individual effects; and 6) heteroskedasticity and autocorrelation within individuals, but not across them. Arellano-Bond estimation starts by transforming all regressors, usually by differencing, and uses the Generalised Method of Moments, and so is called "difference GMM" (Hansen 1982). The technical discussion of the methodology is given in the next section.

Section III
Methodology for estimating the effect of agricultural credit on production: A dynamic panel regression approach

III.1. Economic framework

When the farmer faces a credit constraint, additional credit supply can raise input use, investment, and hence output. This is the liquidity effect of credit. But credit has another role to play. In most developing countries where agriculture still remains a risky activity, better credit facilities can help farmers smooth out consumption and, therefore, increase the willingness of risk-averse farmers to take risks and make agricultural investments. This is the consumption smoothing effect of credit. Therefore, specification of an appropriate model of agricultural credit and output is fraught with several econometric difficulties. First, time series data on informal credit do not exist. If expansion of formal credit causes a reduction in informal credit, a regression of output on formal credit will measure the effect of expansion of credit net of the effect of reduced informal credit. The second econometric problem is the joint dependence of output and credit on other variables such as the weather, prices, or technology. Credit advanced by formal lending agencies such as banks is an outcome of both the supply of and demand for formal credit. The amount of formal credit available to the farmer, his credit ration, enters into his decision to make investments, and to finance and use variable inputs such as fertilizer and labor. There is, therefore, a joint dependence between the observed levels of credit used and aggregate output. A two-stage instrument variable (IV) procedure can solve this identification problem. The third econometric problem arises because formal agriculture lending is not exogenously given or randomly distributed across space. That means, the banks will lend more in areas where agricultural opportunities are better, risk is lower, and hence, chances for loan recovery are higher. An unobserved variable problem thus arises for the econometric estimation and is associated with unmeasured or immeasurable region, say district characteristics. This problem can be overcome by the use of district-level panel data. The credit delivery to agriculture will have differential impacts over different regions in India. Even various districts in same state may be responding in a different manner to the change in credit delivery. Therefore, any methodology where data are pooled together will not be appropriate. Again, assuming exogeneity in the independent variables may lead to wrong results as the variables like area under cultivation may depend on last periods' output. For example, an increase (decrease) in output in a particular district at any particular year leads to the chances of more (less) area of showing in the next year which increases (decreases) the likelihood of higher production in the subsequent year. This led us analyzing the data using a dynamic panel data analysis with instrumental variables using Arellano-Bond Regression. Using some select states, district level panel data is obtained and analyzed allowing district level unobserved heterogeneity.

III.2. Panel data methodology

Panel data is widely used to estimate dynamic econometric models. Its disadvantage over cross-section data is that we cannot estimate dynamic models from observations at a single point in time, and it is rare for single cross section surveys to provide sufficient information about earlier time periods for dynamic relationships to be investigated. Its advantages over aggregate time series data include the possibility that underlying microeconomic dynamics may be obscured by aggregation biases, and the scope that panel data offers to investigate heterogeneity in adjustment dynamics between different panels. A single equation, autoregressive-distributed lag model can be estimated from panels with a large number of cross-section units, each observed for a small number of time periods. This situation is typical of micro panel data and calls for estimation methods that do not require the time dimension to become large in order to obtain consistent parameter estimates. Assumptions about the properties of initial conditions also play an important role in this setting, since the influence of the initial observations on each subsequent observation cannot safely be ignored when the time dimension is short. In case of absence of strictly exogenous explanatory variables or instruments as strict exogeneity rules out any feedback from current or past shocks to current values of the variable, which is often not a natural restriction in the context of economic models relating several jointly determined outcomes (Bond, 2002). Identification then depends on limited serial correlation in the error term of the equation, which leads to a convenient and widely used class of Generalised Method of Moments (GMM) estimators for this type of dynamic panel data model.

Consider a simple AR(1) model,

$$y_{it} = \alpha y_{i,t-1} + \eta_i + v_{it}; \; |\alpha| < 1 \qquad (3.1)$$
$$i = 1......N$$
$$t = 2,3,....T$$

where y_{it} is an observation on some series for individual i in period t, $y_{i,t-1}$ is the observation on the same series for the same individual in the previous period, η_i is an unobserved individual-specific time-invariant effect which allows for heterogeneity in the means of the y_{it} series across individuals, and v_{it} is a disturbance term. A key assumption that is maintained throughout is that the disturbances v_{it} are independent across individuals. The number of individuals for which data is available (N) is assumed to be large whilst the number of time periods for which data is available (T) is assumed to be small, and asymptotic properties are considered as N becomes large with T fixed.

The individual effects (η_i) are treated as being stochastic, which implies that they are necessarily correlated with the lagged dependent variable $y_{i,t-1}$ unless the distribution of the η_i is degenerate. Initially it is further assumed that the disturbances (v_{it}) are serially uncorrelated. These jointly imply that the Ordinary Least Squares (OLS) estimator of α in the levels equations (3.1) is inconsistent, since the explanatory variable $y_{i,t-1}$ is positively correlated with the error term ($\eta_i + v_{it}$) due to the presence of the individual effects, and this correlation does not vanish as the number of individuals in the sample gets larger. The within groups estimator eliminates this source of inconsistency by transforming the equation to eliminate η_i. Although within groups estimator is biased, in large samples, it is biased downwards. In specifying the model (3.1) no restriction to the process that generates these initial conditions is made, and a wide variety of alternative processes could be considered (Bond, 2002).

Instrumental variables estimators, which require much weaker assumptions about the initial conditions, have therefore been attractive in this context. Additional instruments are available when the panel has more than 3 time series observations. Whilst y_{i1} is the only instrument that can be used in the first differenced equation for period t = 3, both y_{i1} and yi_2 can be used in the first differenced equation for period t = 4, and the vector ($y_{i1}, y_{i2}, \ldots, y_{i,T-2}$) can be used in the first-differenced equation for period t = T. Since the model is over identified with T > 3, and the first-differenced error term Δv_{it} has a first-order moving average form of serial correlation if the maintained assumption that the v_{it} are serially uncorrelated is correct, 2SLS is not asymptotically efficient even if the complete set of available instruments is used for each equation and the disturbances v_{it} are homoskedastic. The Generalised Method of Moments (GMM), developed by Hansen (1982), provides a convenient framework for obtaining asymptotically efficient estimators in this context, and first-differenced GMM estimators for the AR(1) panel data model are developed by Holtz-Eakin, Newey and Rosen (1988) and Arellano and Bond (1991).

Essentially these use an instrument matrix of the form

$$Z_i = \begin{bmatrix} y_{i1} & 0 & 0 & . & 0.... & 0 \\ 0 & y_{i1} & y_{i2} & . & 0.... & 0 \\ . & . & . & . & ..... & . \\ 0 & 0 & 0 & y_{i1} & ..... & y_{iT-2} \end{bmatrix} \tag{3.2}$$

where rows correspond to the first-differenced equations for periods t=3, 4, . . . ,T for individual i, and exploit the moment conditions

$$E\left[Z_i^{'}\Delta v_i\right] = 0 \qquad \text{for i=1,2….N} \tag{3.3}$$

where $\Delta v_i = \left(\Delta v_{i3}, \Delta v_{i4,} ....\Delta v_{iT}\right)^{'}$

In general, the asymptotically efficient GMM estimator based on this set of moment conditions minimises the criterion

$$J_N = \left(\frac{1}{N}\sum_{i=1}^{N}\Delta v_i^{'} Z_i\right) W_N \left(\frac{1}{N}\sum_{i=1}^{N} Z_i^{'}\Delta v_i\right) \tag{3.4}$$

using the weight matrix

$$W_N = \left[\frac{1}{N}\sum_{i=1}^{N}\left(Z_i^{'}\Delta\hat{v}_i\Delta\hat{v}_i^{'}Z_i\right)\right]^{-1} \tag{3.5}$$

where the Δv_i are consistent estimates of the first-differenced residuals obtained from a preliminary consistent estimator. Hence this is known as a two-step GMM estimator. Under homoskedasticity of the v_{it} disturbances, the particular structure of the first-differenced model implies that an asymptotically equivalent GMM estimator can be obtained in one-step, using instead the weight matrix

$$W_{1N} = \left[\frac{1}{N}\sum_{i=1}^{N}\left(Z_i^{'}HZ_i\right)\right]^{-1} \tag{3.6}$$

where H is a (T − 2) square matrix with 2's on the main diagonal, -1's on the first off-diagonals and zeros elsewhere. Notice that W_{1N} does not depend on any estimated parameters.

At a minimum this suggests that the one-step estimator using W_{1N} is a reasonable choice for the initial consistent estimator used to compute the optimal weight matrix W_N and hence to compute the two-step estimator. In fact a lot of applied work using these GMM estimators has focused on results for the one-step estimator rather than the two-step estimator. This is partly because simulation studies have suggested very modest efficiency gains from using the two-step version, even in the presence of considerable heteroskedasticity, but more importantly because the dependence of the two-step weight matrix on estimated parameters makes the usual asymptotic distribution approximations less reliable for the two-step estimator. Simulation studies have shown that the asymptotic standard errors tend to be much too small, or the asymptotic t-ratios much too big, for the two-step estimator, in sample sizes where the equivalent tests based on the one-step estimator are quite accurate (Bond, 2002).

In general, autoregressive-distributed lag models of the form

$$y_{it} = \Sigma_j (\alpha_j y_{i,t-j}) + \beta x_{it} + (\eta_i + v_{it}); \text{ i = 1, 2, . . , N;}$$

$$\text{j=1,2 T ; t = (T-j), (T-j-1) . . , T} \qquad (3.7)$$

where y_{it} is the vector of dependant variable. x_{it} can be a vector of current and lagged values of additional explanatory variables.

Maintaining also that the v_{it} disturbances are serially uncorrelated, the x_{it} series may be endogenous in the sense that x_{it} is correlated with v_{it} and earlier shocks, but x_{it} is uncorrelated with $v_{i,t+1}$ and subsequent shocks; predetermined in the sense that x_{it} and v_{it} are also uncorrelated, but x_{it} may still be correlated with $v_{i,t-1}$ and earlier shocks; or strictly exogenous in the sense that x_{it} is uncorrelated with all past, present and future realisations of v_is. If x_{it} is assumed to be endogenous then it is treated symmetrically with the dependent variable y_{it}. In this case the lagged values $x_{i,t-2}$, $x_{i,t-3}$ and longer lags (when observed) will be valid instrumental variables in the first-differenced equations for periods t = 3, 4, . . . , T . Maintaining also that the initial conditions y_{i1} are predetermined, the complete set of moment conditions available has the form of (3), in which the vector $(y_{i1}, \ldots, y_{i,t-2})$ is replaced by the vector $(y_{i1}, \ldots, y_{i,t-2}, x_{i1}, \ldots, x_{i,t-2})$ in forming each row of the instrument matrix Z_i. If we make the stronger assumption that there is no contemporaneous correlation and the x_{it} series is predetermined, then $x_{i,t-1}$ is additionally available as a valid instrument in the first-differenced equation for period t. In this case $(y_{i1}, \ldots, y_{i,t-2})$ is replaced by the vector $(y_{i1}, \ldots, y_{i,t-2}, x_{i1}, \ldots, x_{i,t-2}, xi_{,t-1})$ to form the instrument matrix Zi. If we make the much stronger assumption that x_{it} is strictly exogenous, then the complete time series $x_i = (x_{i1}, x_{i2}, \ldots, x_{iT})$ will be valid instrumental variables in each of the first-differenced equations. In this case $(y_{i1}, \ldots,$

$y_{i,t-2}$) is replaced by the vector ($y_{i1}, \ldots, y_{i,t-2}, x\_{i}$) to form the instrument matrix (Bond, 2002).

The only assumption required on the initial conditions y_{i1} is that they are uncorrelated with the subsequent disturbances v_{it} for t = 2, 3. . . T in, which case the initial conditions are said to be predetermined. The correlation between y_{i1} and the individual effects η_i is left unrestricted, and there is no requirement for any stationarity condition to be satisfied. Together with the previous assumption that the disturbances v_{it} are serially uncorrelated, predetermined initial conditions imply that the lagged level $y_{i,t-2}$ will be uncorrelated with Δv_{it} and thus available as an instrumental variable for the first-differenced equations. The resulting 2SLS estimator is consistent in large N, fixed T panels, and identifies the autoregressive parameter α provided at least 3 time series observations are available ($T \geq 3$).

When $T > 3$ and the model is overidentified, the validity of the assumptions used to obtain (3.3) can be tested using the standard GMM test of overidentifying restrictions, or Sargan test. In particular $N{*}J_N$ in (3.4) has an asymptotic $\chi 2$ distribution under the null that these moment conditions are valid (Sargan, 1958, 1988; Hansen, 1982). In this context the key identifying assumption that there is no serial correlation in the v_{it} disturbances can also be tested by testing for no second-order serial correlation in the first-differenced residuals (Arellano and Bond, 1991).

Section IV. Empirical Analysis

Before explaining the results of the regression model as indicated in the earlier section, association in terms of correlation between agriculture credit and output based on the district level data for 2007 is assessed. Then, we discuss the empirical results of the dynamic panel regression using state-level data and finally results of the same based on districts level data of select states are presented.

IV.1. Association between agriculture credit and output: some empirical assessment

Indicus Analytics, a private sector organization, came out with district GDP data, classified by agriculture, industry and others for the year 2007.[1] With a view to analyze the association between agriculture credit and output, the data district GDP from agriculture data (DGDP_AG) of major states are juxtaposed with district-level agricultural credit data (as per place of utilization) as available in Basic Statistical Returns of all scheduled commercial banks (BSR 1, March 2007). In addition to the credit amount outstanding (AG_C), the number of credit accounts to agriculture (N_AG_C) is also used. The (Pearson's) correlation coefficients for districts within the states have been derived to indicate the direction and extent of relationship between GDP and credit. The elasticity of bank credit on GDP has been chosen to measure the responsiveness of the relationship to changes in bank credit to the GDP (Table 6).

The correlation coefficients of GDP and bank credit in respect of agriculture for the states Andhra Pradesh, Chattisgargh, Jharkhand, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttranchal and West Bengal were positive and statistically significant at 1 per cent level. The correlation coefficients were significant for Assam, Bihar, Maharashtra, Meghalaya, Sikkim at 5 per cent level. However, the correlation coefficients were not found significant for the states like Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh and Punjab. The log elasticity of bank credit to GDP of agriculture were highly significant for the states Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and Uttaranchal at one per cent level. Extension of formal credit to agriculture may play a significant role on the agriculture output in these states. On the other hand, bank credit does not seem to play a major role on the agriculture output in Haryana, Jammu & Kashmir, Karnataka and Kerala. The flow of credit for agriculture in the states of Uttar Pradesh, Andhra Pradesh, Maharashtra, West Bengal, Rajasthan, Tamil Nadu, Bihar, Orissa, Assam, Chhattisgarh, Jharkhand, Uttaranchal, etc., are very important as these states contributes significantly towards agriculture GDP and the elasticity of credit to GDP is also significantly high. Interestingly, when agriculture credit is extended to more people, as demonstrated by the number of agricultural credit account, it has translated to higher

Table 6: Correlation of District GDP and Bank Credit at District Level: 2007

State	No. of districts	Correlation (DGDP_ AG, AG_C)	Log-Elasticity (DGDP_ AG, AG_C)	Rank Correlation (DGDP_ AG, N_ AG_C)	Average DGDP_ AG (Rs. lakh)	Average AG_C (Rs. lakh)
1	2	3	4	5	6	7
Andhra Pradesh	22	0.77*	0.66*	0.67*	248234	87346
Assam	23	0.42**	0.70*	0.52**	71483	4386
Bihar	37	0.50**	0.58*	0.60*	69559	17897
Chhattisgarh	16	0.70*	0.67*	0.79*	58961	11783
Gujarat	25	0.19	0.42**	0.50**	152787	48758
Haryana	19	0.12	0.05	0.72*	119075	51571
Himachal Pradesh	12	0.06	0.47**	0.54***	44403	10530
Jammu & Kashmir	14	0.43	0.66	0.77*	56967	7826
Jharkhand	18	0.59*	0.60	0.56**	40816	6420
Karnataka	27	0.12	0.05	0.65*	109415	75980
Kerala	14	-0.19	-0.03	0.42	127711	60785
Madhya Pradesh	45	0.21	0.47*	0.56*	72148	22951
Maharashtra	33	0.37**	0.50*	0.72*	157593	36207
Orissa	30	0.60*	0.46*	0.72*	74577	12722
Punjab	17	0.26	0.36**	0.67*	205346	74078
Rajasthan	32	0.74*	1.02 *	0.67*	106739	40342
Tamil Nadu	27	0.53*	0.64 *	0.62*	96348	64578
Uttar Pradesh	69	0.69*	0.65 *	0.83*	127330	33806
Uttaranchal	13	0.78*	0.49 *	0.70*	41327	10797
West Bengal	17	0.81*	0.55 *	0.70*	276601	28430
Total	**510**	**0.53***	**0.51 ***	**0.70***	**113195**	**35658**

*, ** and *** indicate statistical significance at 1%, 5% and 10%, respectively.
DGDP_AG= District domestic product from agriculture.
AG_C = District level bank credit to agriculture.
N_AG_C = District level bank credit account to agriculture.

output. This is true for most of the states, except Kerala. Therefore, empirical association clearly indicates that financial inclusion of farmers in the organized financial system boosts agriculture output.

With the objective identifying the role of bank credit in agriculture growth, the dynamic panel data regression with instrumental variables is performed with agriculture output as the dependant variable and total outstanding agriculture credit amount, total outstanding agriculture credit accounts, total agriculture area and rainfall as the regressors. Here analysis is done in two parts. First, an all India level analysis is undertaken involving all the variables for which data are available at state level, in a panel setup, which allows state level unobserved heterogeneity in the model. Secondly, using data of some select states, district level panel data model is estimated and analyzed allowing district level unobserved heterogeneity.

IV.2 Aggregate analysis using State-level panel data

In this section, 20 major states in India are included in the analysis for a period from 2001 to 2006.[2] The period of study is confined to the above mentioned time period mainly due the restricted data availability. The state-wise agriculture output is obtained from the 'State wise estimates of value of output from agriculture and allied activities (Base: 1999-2000)', Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India. The total rainfall in the monsoon season (June to September) is used to obtain the excess/deficit rainfall in different subdivisions for different years. The state level data on total credit outstanding and total number of credit accounts for the scheduled commercial banks are available in the 'Basic Statistical Returns of Scheduled Commercial Banks in India', Reserve Bank of India. This data source is utilised to obtain the credit amount outstanding and total number of agriculture accounts for direct, indirect and total agriculture credit of schedule commercial banks in India. All the variables except rainfall is standardized using population size of the state obtained from the projected data of 2001 population census. The variables used in the study are mentioned below as follows.

pcagout	Per capita agriculture output in rupees
pctacam	Per capita total agriculture credit amount outstanding in rupees

pctacn	Per capita total number of agriculture credit accounts outstanding per one lakh population
pcagar	Total agriculture area in square meter standardized by population
rain	Absolute deviation from normal rain.
pcdacam	Per capita agriculture direct credit amount outstanding in rupees
pcidacam	Per capita agriculture indirect credit amount outstanding in rupees
pcdacn	Per capita number of direct agriculture credit accounts outstanding per one lakh population
pcidacn	Per capita number of indirect agriculture credit accounts outstanding per one lakh population

A dynamic panel regression model is estimated with per capita agriculture output as the dependent endogenous variable. The per capita direct agriculture credit amount outstanding, per capita direct agriculture credit number of accounts, pre capita indirect agriculture credit amount outstanding, pre capita indirect agriculture credit number of accounts and agriculture area are used as predetermined regressors, while rainfall is treated as a strictly exogenous variable. The lagged values of the endogenous and predetermined variables; and exogenous variable are used as instrumental variables. All variables except rainfall used in this equation and subsequent equations are in their first difference form. As described in the above section a difference GMM is used to obtain the parameter estimates. The results obtained from one-step are reported because of downward bias in the computed standard errors in two-steps. The validity of the instruments is verified using Sargan test for over identifying restrictions and is found to be satisfactory (*Note* in Table 7). The difference residuals exhibited significant first order serial correlation and no second order serial correlation (*Note* in Table 7). Therefore it satisfies another essential assumption for the consistency of the system GMM estimator *i.e.* no serial correlation in the error terms.

The results from Table 7 reveal that only agriculture area is significant in explaining the variation in agriculture output, even after

Table 7: GMM estimates for the all India level regression equation

Variable	GMM estimates	Robust Std. Err.	z	Prob.	[95% Conf. Interval]	
Δpcagout (-1)	1.0724	0.1176	9.1200	0.0000	0.8420	1.3029
Δpcdacam	-0.0166	0.0276	-0.6000	0.5480	-0.0708	0.0375
Δpcdacam(-1)	0.0172	0.0335	0.5100	0.6080	-0.0485	0.0829
Δpcdacn	-0.0155	0.0102	-1.5200	0.1280	-0.0354	0.0045
Δpcdacn(-1)	0.0164	0.0132	1.2400	0.2140	-0.0095	0.0422
Δpcidacam	0.1148	0.0589	1.9500	0.0510	-0.0007	0.2302
Δpcidacam (-1)	-0.0579	0.0398	-1.4600	0.1450	-0.1359	0.0200
Δpcidacam (-2)	-0.0728	0.0582	-1.2500	0.2110	-0.1868	0.0412
Δpcidan	0.2434	0.1713	1.4200	0.1550	-0.0923	0.5792
Δpcidan (-1)	-0.2793	0.2355	-1.1900	0.2360	-0.7408	0.1822
Δpcidan (-2)	0.2371	0.1518	1.5600	0.1180	-0.0604	0.5346
Δpcagar	0.0234	0.0051	4.6000	0.0000	0.0134	0.0333
Rain	-0.1800	0.2412	-0.7500	0.4560	-0.6528	0.2928

Note:
GMM results are one-step estimates with heteroskedasticity-consistent standard errors and test statistics.
Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
H0: no autocorrelation z = -2.00 Pr > z = 0.0454
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
H0: no autocorrelation z = 0.95 Pr > z = 0.3404
Sargan test of over-identifying restrictions: chi2(25) = 6.64 Prob > chi2 = 0.99
(Sargan is a test of the over identifying restrictions for the GMM estimators, asymptotically $\chi 2$. This test uses the minimised value of the corresponding two-step GMM estimators.)

adjustment of heteroskedasticity-consistent standard errors. Thus, the credit-output relationship of agriculture is difficult to establish at the state level. Agriculture is typically a localized regional economic activity and, therefore, its aggregation over states may hide the spatial heterogeneity. In order to establish a clear picture of the impact of agriculture credit on agriculture output, we examined further by drilling down to district level and the results are discussed in the section below.

IV.3 State Level Analysis with Districts as the Panel

As the agriculture activities tend to perform rather different across districts, a district level panel data is obtained and analyzed allowing district level unobserved heterogeneity. The data of the variables mentioned in the previous subsection are not available for all the districts in India. Therefore, the analysis is performed for districts of select states namely Maharashtra, Andhra Pradesh, Punjab and West Bengal. The period of study is from 2001 to 2006. The district level agriculture output is not available as such in public domain. But district wise production and farm harvest prices of various agriculture commodities are available with Directorate of Economic and Statistics, Department of Agriculture and Corporation, Ministry of Agriculture, Government of India.[3] This information is utilised to estimate the district level agriculture output. For compilation of this only main agriculture commodities are selected.[4] The cultivated area of different agriculture crops is also available from the same source and this information is utilised to obtain the area under cultivation for different districts. The subdivision wise normal and actual rainfall is published on a regular basis by Indian Metrological Department. The total rainfall in the monsoon season (June to September) is used to obtain the excess/deficit rainfall in different subdivisions for different years. The district level data on total credit outstanding and total number of credit accounts for the schedule commercial banks are available in Basic Statistical Returns of Scheduled Commercial Banks, Reserve Bank of India. This source of data also provide the information on credit amount outstanding and total number of agriculture accounts for direct, indirect and total agriculture credit of schedule commercial banks in India.[5] All the variables expect rainfall is standardized using population size of the district obtained from 2001 population census.

The first model identifies the effect of per capita direct agriculture credit amount outstanding and per capita indirect agriculture credit amount outstanding on per capita agriculture output (Table 8). This model is estimated with per capita agriculture output as the dependent endogenous variable. The per capita direct agriculture credit amount outstanding, per capita indirect agriculture credit amount outstanding and agriculture area are used as predetermined regressors, while rainfall is treated as a strictly exogenous variable. The lagged values of the endogenous and predetermined variables and exogenous variables are used as instrumental variables. All variables except rainfall used in this equation and subsequent equations are in their first difference form. As described in the above section a difference GMM is used to obtain the parameter estimates. Again, the results obtained from one-step are reported because of downward bias in the computed standard errors in two-step. The validity of the instruments is verified using Sargan test for over identifying restrictions and is found to be satisfactory (*Note* in Table 8). The difference residuals exhibited significant first order serial correlation and no second order serial correlation (*Note* in Table 8). Therefore it satisfies the essential assumption for the consistency of the system GMM estimator *i.e.* the assumption of no serial correlation in the error terms.

The results presented in Table 8 indicate that agriculture area is having a significant positive impact and rainfall (measured as deviation from normal) is negatively affecting the agriculture output and is significant, which is consistent with the general beliefs. It can be noted from Table 8 that indirect agriculture credit amount and its first lag are insignificant in describing the variation in the

Table 8: GMM estimates for the second regression equation

Variable	GMM estimates	Robust Std. Err.	z	Prob.	[95% Conf. Interval]	
1	2	3	4	5	6	7
Δpcagout (-1)	0.0605	0.1531	0.3900	0.6930	-0.2396	0.3605
Δpcdacam	0.1100	0.0317	3.4700	0.0010	0.0479	0.1722
Δpcidacam	0.1683	0.1739	0.9700	0.3330	-0.1726	0.5093
Δpcidacam (-1)	0.0980	0.1026	0.9600	0.3390	-0.1030	0.2990
Δpcagar	0.5268	0.1501	3.5100	0.0000	0.2326	0.8211
Rain	-0.8378	0.3039	-2.7600	0.0060	-1.4334	-0.2421

Note:
GMM results are one-step estimates with heteroskedasticity-consistent standard errors and test statistics.
Arellano-Bond test that average auto covariance in residuals of order 1 is 0:
H0: no autocorrelation z = -2.17 Pr > z = 0.0298
Arellano-Bond test that average auto covariance in residuals of order 2 is 0:
H0: no autocorrelation z = 1.09 Pr > z = 0.2753
chi2(11) = 19.52 Prob > chi2 = 0.0529
(Sargan is a test of the over identifying restrictions for the GMM estimators, asymptotically $\chi 2$. This test uses the minimised value of the corresponding two-step GMM estimators.)

agriculture output. On the other hand, the intervention through direct agriculture credit has significant positive impact on agriculture output. In particular, change in per capita agriculture direct credit (amount outstanding) by one per cent will lead to increase in per capita agriculture output by 0.11 per cent. This effect is, however, more stronger from the area under cultivation; an increase in per capita agriculture area by one per cent has the potential of raising the per capita agriculture output by more than 0.5 per cent. The output effect of rainfall on agriculture in India is still very severe; the deviation of rainfall from normal by one per cent could adversely affect agriculture output growth by 0.8 per cent.

The above defined regression equation is further modified by including number of accounts of direct agriculture credit and number of indirect agriculture credit accounts. The parameters are estimated using difference GMM (Table 9). The lagged values of the endogenous and predetermined variables and exogenous variables are used as instrumental variables. The validity of the instruments and assumption of no serial correlation in the error terms are tested using Sargan test for over identifying restrictions and Arellano-Bond test (*Note* in Table 9) and are found to be satisfactory.

The results from Table 9 reveal that the direct agriculture credit amount is significant and positively explains the variation described in the agriculture output. While the number of indirect agriculture credit accounts is significant at 10 per cent level and positive at first lag. That is more people benefited from the indirect finance to agriculture current year may lead to higher output next year. As in the case of earlier models agriculture area is having a significant positive impact and rainfall (measured as deviation from normal) is negatively affecting the agriculture output. However, the effect of rainfall deviation from normality to agriculture output got substantially reduced once we control for the financial inclusion indicator like number of people covered under agricultural loan facilities from the formal institutional mechanism. The indirect agriculture amount outstanding and direct number of agriculture accounts is found to be insignificant in explaining the variation in agriculture output.

Table 9: GMM estimates for the second regression equation

Variable	GMM estimates	Robust Std. Err.	Z	Prob.	[95%	Conf. Interval]
1	2	3	4	5	6	7
Δpcagout (-1)	0.1292	0.1040	1.2400	0.2140	-0.0745	0.3329
Δpcdacam	0.1050	0.0259	4.0500	0.0000	0.0542	0.1558
Δpcdacn	-0.0121	0.0101	-1.2000	0.2320	-0.0318	0.0077
Δpcidacam	-0.1215	0.1017	-1.1900	0.2320	-0.3208	0.0779
Δpcidacam (-1)	-0.0132	0.0252	-0.5200	0.6010	-0.0625	0.0361
Δpcidan	0.1926	0.1461	1.3200	0.1870	-0.0938	0.4791
Δpcidan (-1)	0.2330	0.1251	1.8600	0.0630	-0.0122	0.4783
Δpcagar	0.6321	0.1470	4.3000	0.0000	0.3441	0.9202
Rain	-0.2447	0.2947	-0.8300	0.4060	-0.8223	0.3330

Note:
GMM results are one-step estimates with heteroskedasticity-consistent standard errors and test statistics.
Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
H0: no autocorrelation z = -4.48 Pr > z = 0.0000
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
H0: no autocorrelation z = 1.61 Pr > z = 0.1082
Sargan test of over-identifying restrictions: chi2(46) = 62.74 Prob > chi2 = 0.051
(Sargan is a test of the over identifying restrictions for the GMM estimators, asymptotically $\chi 2$. This test uses the minimised value of the corresponding two-step GMM estimators.)

Section V. Concluding Remarks

Over the years there has been a significant increase in the access of rural cultivators to institutional credit and, simultaneously, the role of informal agencies, including moneylenders, as a source of credit has declined. Available data suggest that agricultural credit has been rising in recent years as a share of both the value of inputs and the value of output. Among the striking features of the agricultural credit scene in India are the wide regional disparities in the disbursement of agricultural credit by scheduled commercial banks. At the same time the share of agricultural GDP is falling in total GDP. In this context this paper examines the role of direct and indirect agriculture credit in the agriculture production taking care of the regional disparities in agriculture credit disbursement and agriculture production in an econometric framework. This is done using Dynamic Panel Data Analysis with Instrumental Variables using Arellano-Bond Regression using district level data from four select states namely Maharashtra, Andhra Pradesh, Punjab and West Bengal belonging to four different regions in India. Using Arellano-Bond Regression this paper tries to address two econometric problems namely joint dependence of output and credit and unmeasured or immeasurable district characteristics.

The analysis suggests the direct agriculture credit amount has a positive and statistically significant impact on agriculture output and its effect is immediate. The number of accounts of the indirect agriculture credit also has a positive significant impact on agriculture output, but with a year lag. These results reveal that even though there are several gaps in the present institutional credit delivery system like inadequate provision of credit to small and marginal farmers, paucity of medium and long-term lending and limited deposit mobilisation and heavy dependence on borrowed funds by major agricultural credit purveyors, agriculture credit is still playing a critical role in supporting agriculture production in India. As suggested by Mohan (2006), its role can be further enhanced by much greater financial inclusion by involving of region-specific market participants, and of private sector suppliers in all these activities, and credit suppliers ranging from public sector banks, co-operative banks, the new private sector banks and micro-credit suppliers, especially self-help groups.

Notes:

1 **District GDP of India, 2006-07 - Methodology :** At the first step, Gross State Domestic Product, 2006-07 for each Sector has been estimated for the year 2006-07 using CSO's time series GSDP figures at factor cost and at current prices for 1999-00 to 2005-06. Secondly, in order to distribute these state GDP numbers across districts, variables/indicators have been identified that have the most significant impact on GDP for that specific sector with the help of a detailed econometric analysis. Third, based on these variables an index is created separately for each sector and this index proportion is used to distribute the state level GDP figures obtained across districts within a state. Fourth, district level GDP obtained as above have been crosschecked with already published Government figures for districts from three states- Andhra & Arunachal Pradesh, Karnataka and Jammu & Kashmir for 2000-2001 so as to maintain consistency. Since GDP is estimated for all districts in the country, same methodology is adopted for all states. This obviously puts certain limitations on data that could be used, given the divergence in data availability across time and across states. The main data sources used for the analysis are NAS, CSO, RBI, Census (2001), National Sample Survey Organization's, NDSSPI etc.

2 States included are: Andhra Pradhesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradhesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradhesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradhesh, Uttarakhand and West Bengal.

3 The data is available in the Ministry's website *http://www.dacnet.nic.in/eands/APY_96_To_06.htm*

4 List of these commodities include Arhar (Tur), Bajra, Cotton (lint), Gram, Groundnut, Jowar, Maize, Rapeseed & Mustard, Rice, Soyabean, Sugarcane and Wheat.

5 At present, scheduled commercial banks (excluding RRBs) are expected to ensure that priority sector advances constitute 40 per cent of net bank credit and within the overall lending target of 40 per cent, 18 per cent of net bank credit goes to the agricultural sector. To ensure that the focus of banks on direct agricultural advances does not get diluted, lending under indirect finance should not exceed one-fourth of the agricultural sub-target of 18 per cent, i e, 4.5 per cent of net bank credit. The classification of direct and indirect agriculture loans by scheduled commercial banks in India are given in Annex 2.

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Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.1	Finance to individual farmers [including Self Help Groups (SHGs) or Joint Liability Groups (JLGs), i.e. groups of individual farmers, provided banks maintain disaggregated data on such finance] for Agriculture and Allied Activities (dairy, fishery, piggery, poultry, bee-keeping, etc.)	1.3	Finance for Agriculture and Allied Activities	1.3.11	Advances to Custom Service Units managed by individuals, institutions or organisations who maintain a fleet of tractors, bulldozers, well-boring equipment, threshers, combines, etc., and undertake work for farmers on contract basis.
1.1.1	Short-term loans for raising crops, i.e. for crop loans. This will include traditional/non-traditional plantations and horticulture.	1.3.1	Two-third of loans to entities covered under 1.2 above in excess of Rs. one crore in aggregate per borrower for agriculture and allied activities.	1.3.12	Finance extended to dealers in drip irrigation/ sprinkler irrigation system/agricultural machinery, irrespective of their location, subject to the following conditions: The dealer should be dealing exclusively in such items or if dealing in other products, should be maintaining separate and distinct records in respect of such items. A ceiling of up to Rs. 30 lakh per dealer should be observed.
1.1.2	Advances up to Rs. 10 lakh against pledge/hypothecation of agricultural produce (including warehouse receipts) for a period not exceeding 12 months, irrespective of whether the farmers were given crop loans for raising the produce or not.	1.3.2	Loans to food and agro-based processing units with investments in plant and machinery up to Rs. 10 crore, undertaken by those other than 1.1.6 above.	1.3.13	Loans to *Arthias* (commission agents in rural/ semi-urban areas functioning in markets/ *mandies*) for extending credit to farmers, for supply of inputs as also for buying the output from the individual farmers/ SHGs/ JLGs.

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.1.3	Working capital and term loans for financing production and investment requirements for agriculture and allied activities.	1.3.3	Credit for purchase and distribution of fertilizers, pesticides, seeds, etc. Loans up to Rs. 40 lakh granted for purchase and distribution of inputs for the allied activities such as cattle feed, poultry feed, etc.	1.3.14	Fifty per cent of the credit outstanding under loans for general purposes under General Credit Cards (GCC).
1.1.4	Loans to small and marginal farmers for purchase of land for agricultural purposes.	1.3.4	Finance for setting up of Agriclinics and Agribusiness Centres.	1.3.15	The deposits placed in RIDF with NABARD by banks on account of non-achievement of priority sector lending targets/sub-targets and **outstanding** as on the date of this circular would be eligible for classification as indirect finance to agriculture sector till the date of maturity of such deposits or March 31, 2010, whichever is earlier.

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.1.5	Loans to distressed farmers indebted to non-institutional lenders, against appropriate collateral or group security.	1.3.5	Finance for hire-purchase schemes for distribution of agricultural machinery and implements.	1.3.16	Loans already disbursed and outstanding as on the date of this circular to State Electricity Boards (SEBs) and power distribution corporations/companies, emerging out of bifurcation/restructuring of SEBs, for reimbursing the expenditure already incurred by them for providing low tension connection from step-down point to individual farmers for energising their wells and for Systems Improvement Scheme under Special Project Agriculture (SI-SPA), are eligible for classification as indirect finance till the dates of their maturity/repayment or March 31, 2010, whichever is earlier. Fresh advances will, however, not be eligible for classification as indirect finance to agriculture.
1.1.6	Loans granted for pre-harvest and post-harvest activities such as spraying, weeding, harvesting, grading, sorting, processing and transporting undertaken by individuals, SHGs and cooperatives in rural areas.	1.3.6	Loans to farmers through Primary Agricultural Credit Societies (PACS), Farmers' Service Societies (FSS) and Large-sized Adivasi Multi Purpose Societies (LAMPS).	1.3.17	Loans to National Co-operative Development Corporation (NCDC) for on-lending to the co-operative sector for purposes coming under the priority sector will be treated as indirect finance to agriculture till March 31, 2010.

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.2	Finance to others [such as corporates, partnership firms and institutions] for Agriculture and Allied Activities (dairy, fishery, piggery, poultry, bee-keeping, etc.)	1.3.7	Loans to cooperative societies of farmers for disposing of the produce of members.	1.3.18	Loans to Non-Banking Financial Companies (NBFCs) for on lending to individual farmers or their SHGs/JLGs.
1.2.1	Loans granted for pre-harvest and post harvest activities such as spraying, weeding, harvesting, grading, sorting and transporting.	1.3.8	Financing the farmers indirectly through the co-operative system (otherwise than by subscription to bonds and debenture issues).	1.3.19	Loans granted to NGOs/MFIs for on-lending to individual farmers or their SHGs/JLGs.
1.2.2	Finance up to an aggregate amount of Rs. one crore per borrower for the purposes listed at 1.1.1, 1.1.2, 1.1.3 and 1.2.1 above.	1.3.9	Existing investments as on March 31, 2007, made by banks in special bonds issued by NABARD with the objective of financing exclusively agriculture/allied activities may be classified as indirect finance to agriculture till the date of maturity of such bonds or March 31, 2010, whichever is earlier. Fresh investments in such special bonds made subsequent to March 31, 2007 will, however, not be eligible for such classification.		

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.2.3	One-third of loans in excess of Rs. one crore in aggregate per borrower for agriculture and allied activities.	1.3.10	Loans for construction and running of storage facilities (warehouse, market yards, godowns, and silos), including cold storage units designed to store agriculture produce/ products, irrespective of their location. If the storage unit is registered as SSI unit/micro or small enterprise, the loans granted to such units may be classified under advances to Small Enterprises sector.		

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Micro Finance and Financial Inclusion of Women: An Evaluation

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World over, micro finance is looked upon as means of credit-based poverty alleviation and financial inclusion. This study uses secondary and primary data on SHGs in order to evaluate the role played by these institutions towards financial inclusion of the groups/regions excluded from the formal financial system. In this connection, the study also analyses the geographical spread of micro finance institutions, access and affordability of micro finance for women borrowers and movement of women borrowers out of SHGs. The findings of this study reflect the significantly limited scale and spread of micro finance in India. The continued dependence of women members belonging to mature SHGs on informal sources, as revealed from the primary data, further corroborates the point regarding the limited spread of micro finance. The relatively high rates of interest on SHG loans, which are comparable with the rates of informal sector, underline the issue of affordability of micro finance for poor borrowers. Further, an issue related to interest rates is that of dropouts of members. The most commonly noted cause for dropouts among SHG members is the irregular repayments of loans. The members complain of an inability to repay their loans on time and subsequently drop out. Hence, the observations of this note reflect the considerable scope for micro finance to evolve as an effective means of financial inclusion that is accessible and affordable for the excluded groups/regions and that can help loosen the grip of informal sources of finance and ensure permanent inclusion of the excluded sections in the ambit of formal finance.

JEL Classification : G21

Keywords : Micro-finance, SHGs, Financial Inclusion

This is an evaluation study of micro finance in India using secondary and primary data on SHGs. The primary objective of this study is to evaluate SHGs as a means of financial inclusion of the groups/regions excluded from the formal financial system. In this

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connection, the study looks at the issues of geographical spread of micro finance institutions and SHGs, access and affordability of micro finance for women borrowers and movement of women borrowers out of SHGs.

The study uses secondary data from the annual publication of National Bank for Agriculture and Rural Development (NABARD) on micro finance, namely, "Progress of SHG-Bank Linkage Programme in India". Further, it also uses secondary data from the latest round of All India Debt and Investments Survey conducted by National Sample Survey Organisation (NSSO). The primary data are drawn from a field level survey of SHGs and SHG members conducted in 2006 in Kancheepuram district of Tamil Nadu, a State that has been known to be one of the leading States in the country in the development of micro finance.

The study is organised as follows. In Section I, we introduce the concept of micro finance as it is understood worldwide and as it has been implemented in India. In Section II, we discuss the concept of *financial inclusion* as it is described officially in India and its link with micro finance and the issues involved therein. In Section III, we discuss the secondary data on micro finance to analyse the geographical and agency-wise spread of micro finance in India. We also look at the existing scale of micro finance in India. In Section IV, we discuss first the features of the primary dataset used for the present study and then, our major findings from the primary data. We provide our concluding observations in Section V.

Section I
Concept of Micro Finance and its Implementation in India

Micro finance originated in Bangladesh with the institution of Grameen Bank in 1983. The basic principles of micro finance that distinguish it from the earlier modes of credit delivery are small amounts of loan, lack of physical collateral but emphasis on social collateral or peer monitoring and focus on women borrowers. With these three factors, micro finance is expected to effectively tackle the three problems that are often encountered in any credit delivery programme designed for the poor namely, targeting, screening of borrowers, and enforcement of the credit contract.[1] Under the model of micro finance promoted by the Grameen Bank, women borrowers are organised into Self-Help Groups (SHGs), which would be entitled to borrow from the lending institution either for their individual or group requirements. Such groups are normally created by women from similar socio-economic background that strengthen the solidarity among these women. The involvement of the entire group at each stage of seeking the loan and its repayment is essential in ensuring peer monitoring.

In several countries across the world, micro finance originated from the activity of Non-Governmental Organisations (NGOs) that were aided largely or partly by foreign donors for their lending operations.[2] There were also cases such as in Indonesia, where micro finance was promoted directly through state owned banks/ organisations.

Against this background, the Indian experiment with micro finance was different in mainly two respects. First, India involved its public banks network to provide micro finance. The commercial banking network, whose development after bank nationalisation in terms of geographical spread and functional reach is often deemed unparalleled in the world, was roped in for micro finance. The micro finance experiment in India has been described by NABARD as *relationship* banking rather than *parallel* banking elsewhere in the world.[3] In this experiment, there exists a link between SHGs, NGOs and Banks. The SHGs are formed and nurtured by NGOs and only after accomplishing a certain level of maturity in terms of their internal thrift and credit operations; they are entitled to seek credit from the banks. There is an involvement of the concerned NGO before and even after the SHG-Bank linkage. This variant of micro finance is most popular in India.[4]

Secondly, *thrift* first and not *credit* first was considered to be the basis for micro finance in India. SHGs in India were encouraged towards saving within the group and managing their own finances and giving loans internally and then to deposit their savings with a bank thus providing them access to the banking network and finally, negotiating with the bank for credit.

The SHG-Bank linkage programme, which was undertaken since 1992 in India, had financed about 22.4 lakh SHGs by 2006. It involved commercial banks, Regional Rural Banks (RRBs) and cooperative banks in its operations, the details of which would be discussed in Section III.

Section II
Micro Finance and Financial Inclusion

Financial inclusion has been defined as the "provision of affordable financial services" (RBI, 2006a) to those who have been left unattended or under-attended by formal agencies of the financial system. These financial services include "payments and remittance facilities, savings, loan and insurance services" (*ibid.*). Micro finance has been looked upon as an important means of financial inclusion in India (RBI, 2006b). As already discussed, the Indian concept of micro finance encourages access of SHGs to banks both as means of savings and providers of loan services. However, going a step further, we can say that micro finance has to act proactively not just as a means of financial inclusion and also has to work towards reducing dependence of poor borrowers on various informal sources of credit that are often notorious for the onerous terms at which they offer credit. An effective financial inclusion is possible only with the accomplishment of the second.

Given the definition of financial inclusion, any means for financial inclusion, to begin with, has to be not just easily accessible but also *affordable* to the borrowers, who do not have access to formal financial system. Secondly, it should ensure that over time the borrowers are able to reduce their dependence on informal sources of finance and a certain degree of loyalty towards SHGs, which can work towards *permanent* or *effective* inclusion of these borrowers into the formal banking network.

Section III
Certain Issues regarding the Scale and Spread of Micro Finance in India

The pace at which micro finance has spread in India has been undoubtedly impressive. Taking data from NABARD, we find that the number of SHGs increased significantly from 637 in 1994 to 22.4 lakh by 2006 (Table 1).[5] Similarly, there was a vast increase in the amount of bank credit provided to the SHGs during this period. This includes credit provided by all three key institutions, namely commercial banks, Regional Rural Banks and cooperative banks. Of these, commercial banks have been instrumental in financing the largest number of SHGs till now (Table 2).

Notwithstanding its expansion, there are three observations that need to be made about the scale and spread of micro finance in India. First, regarding its scale, micro finance still remains a minuscule portion of total bank credit in India. The micro finance provided by the two major institutions, namely commercial banks and RRBs constituted less than one per cent of the total credit from these institutions in 2007 (Table 3).[6]

Another interesting *albeit* rough statistic that can highlight the relatively small scale of finance to SHGs is that the *total cumulative credit* disbursed through SHG-Bank linkage programme right from its inception in 1992 to 2006 by commercial banks, RRBs and cooperative banks formed only 6 per cent of the total agricultural credit disbursed in *just one year* of 2005-06 by these institutions together.

Table 1: Cumulative number and amount of credit to SHGs

(Amount in Rs. lakh)

Year	Cumulative number of SHGs		Cumulative amount of bank credit	
	India	Tamil Nadu	India	Tamil Nadu
1994	637	74	80	9
2006	2238565	312778	113975400	27121900

Note : Figures for 1994 pertain only to 11 States, where the pilot project of SHG-Bank linkage was implemented.

Source : NABARD (2006), Nanda (1995).

Table 2: Cumulative number of and amount of credit to SHGs, by agency, 2006

(Amount in Rs. crore)

Agency	Cumulative number of SHGs	Cumulative amount of bank credit
1. Commercial banks	1188040 (53.1)	698745 (61.3)
1.1 Public sector banks	1141570 (51.0)	643968 (56.5)
1.2 Private sector banks	46470 (2.1)	54777 (4.8)
2. Regional Rural Banks	740024 (33.1)	332215 (29.1)
3. Cooperative banks	310501 (13.9)	108795 (9.5)
All banks	**2238565 (100.0)**	**1139754 (100.0)**

Note: Figures in brackets indicate percentage share in total.
Source: NABARD (2006).

Secondly, not only that credit to SHGs had an extremely small share in total credit and total loan accounts, we find that there was a falling trend in these shares during the five-year period from 2002 to 2007 (Table 3).

The third point regarding the regional spread of micro finance is that there has been a significant concentration of these institutions in the Southern region of the country (Table 4).[7] By 2006, more than half of the SHGs were located in the Southern region and about three fourth of

Table 3: Percentage share of credit outstanding to SHGs in total credit outstanding of scheduled commercial banks (including RRBs)

Year	Amount of credit outstanding to SHGs (in Rs. crore)	Total credit outstanding (in Rs. crore)	Number of loan accounts for SHGs	Total loan accounts
2002	41321 (1.8)	2258529	290904 (0.5)	483280
2007	81156 (0.8)	10094629	53034408 (0.3)	166820470

Note : Figures in brackets indicate percentage share of accounts/amount to SHGs in total accounts/amount.
Source: Basic Statistical Returns, various issues.

Table 4: Cumulative number of and amount of bank credit to SHGs, by regions, 2006

Region	Cumulative number of SHGs	Cumulative amount of bank credit
Northern region	133097 (5.9)	39859 (3.5)
North-Eastern region	62517 (2.8)	16570 (1.5)
Eastern region	394351 (17.6)	93542 (8.2)
Central region	267915 (12.0)	80501 (7.1)
Western region	166254 (7.4)	52514 (4.6)
Southern region	1214491 (54.3)	856769 (75.2)
Tamil Nadu	*312778* *(14.0)*	*271219* *(23.8)*
India	**2238565** **(100.0)**	**1139754** **(100.0)**

Notes : 1. Figures in brackets indicate percentage share in total for India.
2. The region-wise classification of States follows from the NABARD publication.
Source : NABARD (2006).

the bank credit was given to SHGs located in this region.[8] Of the total number of SHGs in the Southern region, one fourth were located in Tamil Nadu, the State from which we have primary level information.

Interestingly, the Southern region has historically been the most vanguard region in terms of banking development in the country. A greater concentration of micro finance is possibly owing to the already well-developed banking infrastructure in the region but it further reinforces the existing inequality between regions in the development of banking infrastructure.

Further, as micro finance is essentially driven towards including the poorer sections of the population into the ambit of banking, it is useful to compare the supply of micro finance to the number of poor across regions in order to judge the effective spread of micro finance. We find taking this indicator too, the spread of micro finance works out to be the largest in the Southern region and the smallest in the Central region. We find that the number of SHGs (formed on a cumulative basis) per 1,000 poor persons in the Southern region was about four to five times more than the corresponding figure in other regions.[9] Given that an SHG normally comprises 15 members and that about 60 per cent of SHGs in the country have members from families belonging to the Below Poverty Line (BPL) category (as found by NCAER, 2008), we can estimate that even for the Southern region, only about one third of its poor population is covered by SHGs (Table 5). Further, in the case of Tamil Nadu, the coverage of poor persons by SHGs is only about 8 per cent. Here, however, we need to remember that there are arguments from scholars that the official poverty line under-estimates the number of poor persons in the country (Swaminathan, 2000). In this case, the coverage by SHGs of poor persons is expected to be even narrower.

Fourthly and finally, as micro finance is regarded as a means of drawing greater number of women into the banking system, we analyse the trends in bank credit to and deposits from women and juxtapose the same with the figures for men in order to understand the degree of *absolute* and *relative* financial exclusion of women.

Table 5: Cumulative number of and bank credit to SHGs per person below poverty line, 2005

Region	**Cumulative number of SHGs per thousand persons below poverty line**	**Cumulative bank credit to SHGs per person below poverty line (Rs. '000)**
Northern region	8	24
North-Eastern region	10	28
Eastern region	5	13
Central region	3	10
Western region	5	16
Southern region	36	252
Tamil Nadu	*9*	*37*
India	**9**	**48**

Note : Figure for population below poverty line is taken from NSSO for the year 2004-05. The comparison here assumes that the cumulative number of SHGs were all functional in 2005.

Source : NABARD (2006), GOI (2007).

Here, for women's credit, we consider together (group) credit to SHGs and (individual) credit to women as provided in the Basic Statistical Returns. In the case of deposits, however, as data on (group) deposits from SHGs are not separately available, we consider only the (individual) deposits from women. It may be noted that the (group) credit to SHGs may not be *entirely* credit to women but it is *principally* credit to women and hence, can be clubbed together with individual credit to women for arriving at a proxy for total bank credit to women.

On the bank credit front, there was an evident disparity between women and men. On an average, there were 21 loan accounts per 10,000 women as against 118 loan accounts per 10,000 men in 2007 (Table 6). Further, the average amount of credit outstanding per woman in 2007 was Rs. 1,139 as compared to Rs. 5,652 per man (Table 7). These statistics need to be contrasted with the fact that women constituted half (48.4 per cent) of the total population making 93 women per every 100 men in the country in the same year. If we considered deposits, the proportion worked out to be much higher (Tables 6, 7). During the six-year period considered in Tables 6 and 7, there appeared to be a change towards reducing the gender gap but even then, women's access to basic banking facilities remained at disquietingly low levels.

Table 6: Loan and deposit accounts per 10,000 persons, for women and men

Year	Loan accounts per 10,000 persons		Deposit accounts per 10,000 persons	
	Women	Men	Women	Men
2001	2 (11)	19	2149 (37)	5731
2007	21 (18)	118	2123 (36)	5858

Notes : 1. Figures in brackets indicate percentage share of accounts of women to those of men.
2. Loan accounts for women for 2007 includes individual loan accounts for women and loans accounts of SHGs.

Source : Basic Statistical Returns, various issues, <www.censusindia.net>.

Table 7: Amount of credit and deposits per capita, for women and men

Year	Credit per capita		Deposits per capita	
	Women	Men	Women	Men
2001	625 (15)	4290	3219 (30)	10669
2007	1139 (20)	5652	5310 (30)	17721

Notes : 1. Figures in brackets indicate percentage share of amount of women to that of men.
2. Credit amount for women for 2007 includes individual credit to women and credit of SHGs.

Source : Basic Statistical Returns, various issues, <www.censusindia.net>.

Section IV
Access and Affordability of Micro Finance as Evident from

Primary Data

The primary data are drawn from a field level survey conducted in 2006 in Kancheepuram district of Tamil Nadu by Centre for Micro Finance (CMF).[10] These data are collected through interviews of both SHGs and SHG beneficiaries in the district using structured schedules. These SHGs were promoted and nurtured by Hand-in-Hand, a non-Governmental organisation based on Tamil Nadu that has been working in the field of micro finance. There were 35 SHGs selected for the survey and three members from each SHG were interviewed making the total sample size of 105 members. The SHGs were randomly selected from the group of SHGs who were operational for five years or more in the district. The information on the operation of SHGs was taken from the loan registers maintained with Hand-in-Hand. Further, from each group, the animator or the group leader along with two members were randomly selected for interview.

Certain general observations about the SHG members

The sample of SHG members selected for the survey reveals the following points. First, the entire sample was of women SHG members. Secondly, about 56 per cent of the women interviewed reported a family income of less than Rs. 40,000 per annum making their monthly family income approximately Rs. 3,300. Thirdly, about 26 per cent of these women were housewives, but the rest 74 per cent were engaged in various occupations. The most important being agricultural labour followed by cultivation and then, weaving. Given that Kancheepuram district is known for its silk weaving business, weaving offered an important source of livelihood for these women (though that might not have been the main source of income for their families). Fourthly, about 77 per cent of these women belonged to landless category with no land owned by their respective families. Even those few families, which owned land, had land less than 2 acres making each of such families "marginal" landowners.

Heavy reliance on informal sources of finance

The sampled women members belonging to various SHGs in the studied region relied heavily on other informal sources of finance notwithstanding the fact that they were associated with the SHGs for over five years and in the micro finance parlance, were considered as matured members.

The informal sources, which the surveyed members drew upon, were primarily professional moneylenders (Table 8). There were also members that reported loans from relatives and friends, which as revealed by most primary level surveys, is an innocuous source of finance that is drawn on by any individual in times of need. These loans normally come interest free. However, the loans from moneylenders are loans taken often at heavy (explicit and implicit) rates of interest. Hence, for the present discussion, we mainly focus on loans from moneylenders.

Table 8: Number of loans of SHG members, by sources other than SHGs

Source	Number of loans	Percentage of loans
Bank	10	10.8
Professional moneylenders	39	41.9
Relatives and friends	25	26.9
Other sources	19	20.4
Total	**93**	**100.0**

Source*:* Primary data.

Juxtaposing the data provided by the All India Debt and Investment Survey (AIDIS) in 2003 for Tamil Nadu, we get a fairly similar picture of the predominance of informal sources in general, moneylenders in particular. We find that of the total number of rural households in the State, 68 per cent reported having taken at least one loan from informal sources and of these, 53 per cent reported at least one loan from professional moneylenders (Table 9). Further, only 14.4 per cent of the rural households in the State reported at least one loan from commercial banks. Evidently, there was greater dependence on informal sources, particularly moneylenders in Tamil Nadu than in India as a whole.

High interest cost of micro finance

The interest cost of micro finance was high as revealed by the survey and was in fact comparable to the rates charged by moneylenders. Over 75 per cent of the SHGs surveyed charged rates in the range of 24 to 36 per cent per annum (Table 10). These rates were almost double the rates charged by banks. The modal rate of interest charged

Table 9: Percentage of households reporting at least one loan outstanding, by source

Source	Tamil Nadu	India
Formal Sources	**44.4**	**50.7**
Government	1.9	3.0
Cooperatives	26.1	26.1
Commercial banks	14.4	21.5
Other sources	5.6	2.5
Informal Sources	**68.0**	**58.3**
Landlord	1.4	1.4
Agricultural moneylender	4.6	12.3
Professional moneylender	53.1	25.9
Trader	0.9	3.3
Relatives and friends	7.4	14.1
Others	4.3	3.9

Note : The figures may not add up to 100 as there are households that have taken loans from more than one source.

Source : NSSO (2006).

Table 10: Distribution of SHGs, by rates of interest

Interest rate	Number of SHGs	Percentage of SHGs
12.0	1	3.0
13.2	1	3.0
18.0	5	14.0
24.0	26	74.0
36.0	1	3.0
Not reported	1	3.0
Total	**35**	**100.0**

Source: Primary data.

by banks as revealed by the survey was 12 per cent per annum (Table 11). Interestingly, however, the rates of interest on SHG loans were fairly comparable to the rates charged by moneylenders in the study region; about one third of moneylenders' loans were in the range of 24 to 36 per cent (Table 12). Moneylenders in the region charged even higher rates of interest going up to 240 per cent per annum. Given the

Table 11: Percentage distribution of loans by SHG members from banks, by interest rates

Interest rate equal to	Number of loans	Percentage of loans
9.0	1	10.0
10.0	2	20.0
12.0	3	30.0
Not reported	4	40.0
Total	**10**	**100.0**

Source: Primary data.

Table 12: Percentage distribution of loans by SHG members from moneylenders, by interest rates

Interest rate equal to	Number of loans	Percentage of loans
24	1	2.6
36	13	33.3
60	3	7.7
120	13	33.3
144	3	7.7
240	2	5.1
Not reported	4	10.3
Total	**39**	**100.0**

Source: Primary data.

fact that most of the loans from SHGs were taken towards production related purposes (Table 13), we expect that any member borrowing from SHGs has to get a rate of return of over 24-36 per cent from her business venture in order to break even, which indeed is a high rate of return to be expected from the small business ventures that these women put their funds to.[11]

Again, we compare the data available from the AIDIS in this regard and find that 43 per cent of the rural households in the State reported at least one loan outstanding at rates higher than 30 per cent per annum (Table 14). This was in line with the observation made earlier regarding the dominance of informal sources of finance for households in the State.

Movement of members out of SHGs

Of the total number of SHGs surveyed, more than half of the SHGs (18 SHGs) reported dropouts of up to 3 members since the time of their formation (Table 15).[12] As against this, only 6 per cent of the SHGs (2 SHGs) reported an addition of members while about

Table 13: Percentage distribution of loans from SHGs, by purpose

	Purpose	Share in amount	Share in number
1	**Directly income generating activities**	**52.0**	**28.0**
	1.1 Agriculture	12.0	5.0
	1.2 Livestock	1.0	1.0
	1.3 Business/shop	39.0	21.0
	1.3.1 Silk business	14.0	6.0
2	**Consumption related activities**	**44.0**	**70.0**
	2.1 House construction	0.3	0.3
	2.2 Education	6.0	6.0
	2.3 Health	36.0	61.0
	2.4 Ceremonial expenditure	2.0	2.0
	2.5 Others	0.05	0.04
3	**Not reported**	**4.0**	**3.0**
	Total	**100**	**100**

Source: Primary data.

Table 14: Percentage distribution of households reporting at least one loan outstanding, by interest rate classes

Interest rate class	Tamil Nadu	India
0	13.8	17.3
0 < rate ≤ 6	0.7	3.0
6 < rate ≤ 10	2.5	2.8
10 < rate ≤ 12	5.1	5.5
12 < rate ≤ 15	20.2	26.3
15 < rate ≤ 20	19.4	16.3
20 < rate ≤ 25	15.6	14.4
25 < rate ≤ 30	0.4	0.3
30 < rate	43.2	26.8
Not reported	0.0	0.9
Total	**100.0**	**100.0**

Note: Interest rate classes are as given in NSSO (2006).
Source: NSSO (2006).

43 per cent of the SHGs (15 SHGs) had the same number of members since the time of their formation.

For the majority of the groups the dropout rate (number of dropouts as a per cent of the initial number of members) varied between 5 and 10 per cent (Table 16). The number of SHGs tended to fall as we moved towards higher dropout rate classes. When the information was collected from the SHGs to find the possible causes of dropouts, it was observed that most of these members exhibited irregular repayments of their loans. These members complained of an inability to repay their loans and subsequently were either asked

Table 15: Number of SHGs classified by the dropout/ addition of members

SHGs	Number of SHGs	Percentage of SHGs
With dropouts	18	51.4
With no dropouts	15	42.9
With additions	2	5.7
Total	**35**	**100.0**

Source: Primary data.

Table 16: Number of SHGs with dropouts, by dropout rate

Dropout rate	Number	Percentage
0 < rate ≤ 5	1	5.6
5 < rate ≤ 10	8	44.4
10 < rate ≤ 15	4	22.2
15 < rate ≤ 20	4	22.2
20< rate ≤ 25	1	5.6
Total	**18**	**100.0**

Source: Primary data.

to leave by the organisers or they dropped out. The inability to repay needs to be seen in the light of the earlier discussion on interest rates.

There were natural causes like death and other causes, such as migration or husband's/family's opposition for drop outs but they appeared relatively less important. Most (60 per cent) of the members who dropped out, kept their savings with the group, which were used to settle their loans.

Section V
Concluding Observations

This note was a preliminary attempt to understand the scale and spread of micro finance as an important tool of financial inclusion in India using secondary and primary level data.

Following are the major concluding observations from the exercise based on secondary data. First, micro finance *albeit* its expansion has remained a minuscule of bank credit in India. In 2007, that is a decade and half since its inception in the form of SHG-Bank linkage programme, credit to SHGs constituted less than one per cent of the total bank credit from scheduled commercial banks. Secondly, the data available for the last five years show that there has been a falling trend in the percentage share of bank credit to and loan accounts held by SHGs. Thirdly, there has been considerable regional disparity in terms of the spread of micro finance in India. The Southern region of India is way ahead of the other regions not just in terms of the absolute number of SHGs formed and the bank credit supplied to these SHGs but also in terms its coverage of poor persons residing in this region. A comparison with the number of poor persons is useful as micro finance is essentially a means of providing bank credit to the poor sections of the population. Given that the Southern region has been historically one of the well-developed regions in terms of banking infrastructure, this concentration of micro finance undoubtedly adds to regional disparity. Fourthly, as micro finance is primarily driven towards women, the coverage of women under the existing banking network can also be an indicator of the spread of micro finance. Though there are about 93 women per 100 men in India, there were only 21 loan accounts per 10,000 women as compared to 118 loan accounts per 10,000 men in the country. Further, on an average, the amount of bank credit outstanding per woman worked out to Rs. 20 for Rs. 100 outstanding per man. The disparity in terms of deposits was little less but it still reflected the wide gap that prevailed in the financial inclusion of women *vis-à-vis* men.

The major observations based on primary data collected from Kancheepuram district of Tamil Nadu from SHG members and SHGs (functional for over five years) are as follows. First, the surveyed SHG members relied heavily on informal sources of finance in general, moneylenders in particular, despite their longstanding association with their respective SHGs. The dependence on professional moneylenders of rural households in Tamil Nadu also came out from the data provided by the recent All India Debt and Investment Survey. Secondly, the rates of interest of SHG loans ranged between 24 and 36 per cent per annum, which was almost double the rate on bank credit reported by SHG members and fairly comparable to the rates of interest reported on moneylenders' loans. Thirdly, more than half of the surveyed SHGs reported dropouts of up to 3 members per group and the major reason for dropping out as reported by SHGs was the inability of the concerned members to repay on time and hence, either the members dropped out on their own or they were asked to leave by the organisers. Majority of these members, however, left their savings with the groups which were used to settle their loans.

To conclude, the findings of this study reflect the significantly limited scale and spread of micro finance in India. The continued dependence of women members belonging to mature SHGs on informal sources corroborates the point made earlier regarding the spread of micro finance. The high interest rates on SHG loans also points towards the affordability of micro finance for the poorer borrowers who in effect are expected to have a very high rate of return from their business ventures in order to just cover the interest cost. Hence, the observations made in this note reflect the considerable scope for micro finance to evolve as a means of financial inclusion that is accessible and affordable for the excluded groups/regions and that can help loosen the grip of informal sources of finance and bring the excluded sections permanently into the ambit of formal finance.

Notes:

[1] See Hulme and Mosley (1996) for a discussion on this issue.

[2] As regards Grameen Bank, it was originally sponsored by the central bank of Bangladesh and some state owned commercial banks and foreign donor institutions. It was subsequently made into an independent banking organisation through government legislation. For a major part from its inception, Grameen Bank relied on funds from foreign donors. However, since 1995, Grameen Bank claims to have become self-reliant and does not rely on foreign funds. See <www.grameen-info.org> for these details.

[3] See Jayaraman (2001).

[4] There are two other major variants of micro finance popular all over the world. In one of these, NGOs directly provide credit to SHGs. They may be seeking credit themselves either from banks or from foreign donor institutions. In the second one of these, banks themselves create and nurture and provide credit to SHGs. For discussion on some other types of variants, see Nanda (1994).

[5] The SHG-Bank linkage programme as a pilot project was started in 1992. However, we were able to get the required information only from 1994 onwards.

[6] For this comparison, we have used data from Basic Statistical Returns, which from 2002 has started capturing the finance given to SHGs and NGOs. It is noteworthy that in India, banks lend very little through NGOs as compared to their own loans to SHGs. We find that credit to NGOs formed only about 11 per cent of the total bank credit to SHGs and NGOs in 2007, see NABARD (2008).

[7] The Region-wise classification of Indian States is given in Appendix I. It follows from the NABARD publications.

[8] In the Southern region, it was Andhra Pradesh that topped the list in terms of the development of micro finance. The regional inequality in micro finance is a point that has been noted earlier in some studies; see for example, Chakrabarti (2005).

[9] As the number is cumulative, we assume here that all those SHGs were functional in 2005.

[10] The survey was conducted by Lucie Gadenne and Veena Vasudevan for CMF. A part of these data were made available to us for our study by the CMF. For various details regarding the survey, we have drawn on the original report by Gadenne and Vasudevan (2007).

[11] The question of what is an ideal rate of return for such small business ventures started with SHG loans is difficult to answer. We found some evidence regarding the rates that are expected by venture capitalists. Based on a sample of venture capitalists from across five countries, one study suggested that these capitalists require a rate of return between 36 and 45 per cent for early stages of investment and 26 and 30 per cent for later stages involving expansions, acquisitions, etc. (Manigart *et al*).

[12] It needs to be reiterated at this juncture that all the SHGs surveyed were functioning for more than 5 years.

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Appendix 1

Region-wise classification of States

Northern region
Haryana
Himachal Pradesh
Jammu and Kashmir
New Delhi
Punjab
Rajasthan
North-Eastern region
Arunachal Pradesh
Assam
Manipur
Meghalaya
Mizoram
Nagaland
Sikkim
Tripura
Eastern region
Andaman and Nicobar Islands
Bihar
Jharkhand
Orissa
West Bengal
Central region
Chhatisgarh
Madhya Pradesh
Uttar Pradesh
Uttarakhand
Western region
Goa
Gujarat
Maharashtra
Southern region
Andhra Pradesh
Karnataka
Kerala
Pondicherry
Tamil Nadu
India

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Non-tax Sources in India – Issues in Pricing and Delivery of Services, Mahesh C.Purohit and Vishnu Kanta Purohit (Gayatri Publications: Delhi), 2010; pp vi+217, Rs. 700.

The book on 'Non-tax Sources in India – Issues in Pricing and Delivery of Services' highlights the significance of non-tax sources in resource mobilising exercise of States, the trade off that exists between economically viable non-tax structure and pricing strategies, which are different for public and private goods. The book spells out its objectives - the structure and trends of non-tax revenue across States, suggestions for rational non-tax structure keeping in view the economic viability to generate larger resources, fiscal measures that is politically palatable and institutional preparedness. The introductory chapter delves on various facets of non-tax sources including its definition, component-wise analysis. The book, however, limits its scope to only those non-tax revenues which originate from administrative departments and departmental undertakings that are of non-commercial nature.

The second chapter sets out the 'Fiscal Significance of States' Own Non-Tax Sources' not only in India but also in other countries. Trends in own non-tax revenue of the Indian states indicate that while there is an increase in absolute term over the years, as percent to aggregate receipts, it has gradually declined from 11.6 per cent in 1993-94 to 8.4 per cent in 2002-03 and further to 2.9 per cent in 2003-04. In terms of contribution of own non-tax revenue to Gross State Domestic Product (GSDP) some of the states indicate an increasing trend such as Goa, followed by Gujarat, Punjab and Tamil Nadu. The study concentrates on the recoveries from economic, social and general services as their growth is more reliable as compared to other sources such as interest receipts, dividend and profits. Though these sources of non-tax revenue have great potential yet these do not have much significance in the State budgets for which policy restructuring is essential.

The third Chapter on 'Pricing Strategy for Non-Tax Revenue', reviews the literature relating to pricing theories for public utilities for different categories of non-tax revenue. The study highlights the difference in pricing strategy for a private good as against for publicly provided private goods and public utilities. The Chapter delineates various pricing theories and keeping in view the limitations of each theory, a mix of these theories is suggested. This Chapter also attempts to elaborate on application of these of theories in various types of utilities. In this context, principles of 'user charges' and related issues such as costs and problems in price measurement as well as issues involved in designing user charges are dealt in detail. Issues with regard to designing appropriate user charges, lack of information, the cost of collection, stickiness of user charges etc., are also set out in detail. Nevertheless, attempt needs to be made to move towards appropriate user charges keeping in view the specific benefits offered by public good/ utility. Further, the study observes the variation in States cost recovery policy in line with the stated objective which shows up in different cost recovery ratios across states.

This is followed by 'Revenue Realisation from Non-Tax Sources' in chapter four which besides focusing on the trends across States and comparative picture in different countries also emphasises the need for a State to improve their recovery rate juxtaposed with the data of other states. The study identifies a desired rate of recovery to its expenditure (RR/RE) for each service which is the norm for all states. Desired RR/RE is 'the rate' which the States should aim at and make continuous efforts to attain. As a second step, the study compares the adequacy of the actual average RR/RE with the actual RR/RE of the best performing State from amongst the 15 major States for each service. An effort is made at estimating relative efficiency of States. The exercise reveals that the RR/RE varies among the services as also among States. Among the major States, Goa's recovery from services as well as from the economic services has been highest as compared to other States. At disaggregated level, RR/RE has risen for only two services (education and roads and bridges) in all States.

Drawing from the above, the chapter five on 'Rationalising Structure of Non-Tax Revenue' reviews the user charges for some of the services keeping in view the objective of equity and efficiency. The chapter attempts to analyse a few select services such as education, medical and public health, water supply and sanitation, *etc*. In doing so, the study draws parallel practices existing in other countries and suggests certain policy prescription in each of the above services to address the principle of equity and efficiency. A key omission in this section is the power sector, which has perhaps the greatest problems in the area of cost recovery. For example, in education, it is suggested that the primary education be subsidised while the user charges for secondary and higher education be designed in such a way that they are progressive according to the income groups. Greater private financing for higher education and involvement of private sector with strong government regulatory mechanism. These principles are of crucial importance for practical policy purpose. It is argued that states would have to accord greater priority to non-tax revenues as ability of government to tap important tax bases is limited.

Keeping in view the above issues, chapter six on 'Procedural Reforms and Issues in Delivery of Service' highlights the amount of pressure on the government in delivery of its services both effectively and efficiently which is greatly influenced by the complexities in the procedure of delivery of services. This undermines the real purpose of service delivery more being access to the needy. Detailing the limitations observed in providing services, the author suggests that there needs to be proper regulation and enforcement to raise awareness level and to create a sense of accountability amongst the service providers through effective use of information technology thereby ensuring efficient service delivery to the needy. To attain good governance and to strike a good balance between client-provider relationships, the study suggests that decentralisation can play a better role in service management.

The concluding chapter on 'Issues and Policy Imperatives' is a nutshell of all the above chapters. The chapter lists out policy prescriptions for select services with a view to garner more resources for the States. A study in non-tax revenue has its own limitations and the introductory chapter lays out some of these. As a result, other sources of non tax revenue like interest receipts and dividend and profits which forms about 13 per cent of States' own non tax revenue are not covered in the study. For instance, the main limitation being data availability and the study observes clearly that there is no uniform practice in data presentation in the budgets across the State governments. Further, not all receipts by the government get accounted for in its consolidated fund. For instance, in education, though students pay a variety of fees, only the tuition fees are credited to the treasury. Similarly, in public health, in some States, the user charges paid by the outpatients are not put into the consolidated fund. The study does not cover power sector which is faced with lot of complexities in collection of resources. The exercise of RR/RE limits itself to the return in value terms and the externalities generated by these goods which are far more and have a long term benefit are not factored in. For example, expenditure in education, public health cannot be measured purely on return in value terms as they have long term benefits. Overall, as the yardstick for comparison of recovery rate being the same across the States, the methodology can be used for measuring inter-State efficiency in collecting the user charges.

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