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INTER-RELATIONSHIP BETWEEN ECONOMIC GROWTH, SAVINGS AND INFLATION IN ASIA

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Abstract

The present study examines the inter- relationship between economic growth, saving rate and inflation for south-east and south Asia in a simultaneous equation framework using two stage least squares with panel data. The relationship between saving rate and growth has been found to be bi-directional and positive. Inflation has a highly significant negative effect on growth but positive effect on saving rate. Inflation is not affected by growth but is largely determined by its past values, and saving rate is not affected by interest rate. These findings for countries in Asia with widely divergent values of aggregates are very relevant for development policies and strategies[4].

JEL classification: C33; E21; E31; E60; O57
Keywords: Growth; Savings; Inflation; Asia; Simultaneity; Fixed-Effect

1. Introduction

Growth experience in south-east and south Asia has generated keen interest among economists and policy makers for the last two decades. Numerous macroeconomic factors affecting economic growth like inflation, savings, foreign exchange rate, etc. have widely varying values across these nations and so also their economic growth. However, almost all these nations are growing at relatively fast rate. Since the growth in some of these economies is often considered resource intensive rather than technology intensive (see, Rosegrant and Evenson, 1992; The World Bank, 2007), savings are likely to play a very important role in promoting real growth. Several empirical studies found a positive effect of the saving rate on the long term growth (Page, 1994; Cardenas and Escobar, 1998; Motely, 1994; and Krieckhaus, 2002) though the neo-classical growth theory predicted only temporary positive effect of increased saving rate on the growth rate in the economy due to corresponding negative effect on capital productivity. The endogenous growth theory (see, Barro and Sala-i-Martin, 1995; and Romer, 2006) de-linking the capital productivity from the savings, explained such positive relationship between long term growth and saving rate. Even the life

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cycle theory for savings would explain the positive relationship between savings and income growth (Loayza et al., 2000). It is, then, important for the policy makers to know what determines the saving rate in order to formulate appropriate policies to promote economic growth. Edwards (1996) found that the level and rates of growth of the GDP were important determinants of savings and discussed the possibility of a bi-directional relationship. The possibility that some other factor affects both growth and savings cannot be ruled out. Literature suggests inflation as one such factor (see, Deaton, 1977; Chopra, 1988; Haslag, 1997; Heer and Suessmuth, 2006; etc.). Does the stability of macroeconomic environment as reflected by inflation play a substantial role in promoting the saving rate and the growth rate?

The effect of inflation on savings, however, is ambiguous both in theory and practice (Heer and Suessmuth, 2006; and Deaton and Paxson, 1993). Empirical evidence about the relationship of inflation and growth differs with some studies finding a negligible effect of inflation on growth (e.g. Chari et al., 1996), some finding a negative effect (Chopra, 1988; Fischer, 1993; Gylfason and Herbertsson, 2001) and some studies providing an evidence of positive effect (Dholakia, 1995; Mallik and Chowdhury, 2001). The effect of inflation on economic growth in theory is largely through the sub-optimal use of resources and distorted investment decisions due to inflation (Miller and Benjamin, 2008; Paul et. al., 1997). However, economic growth leading to high inflation through overheating of the economy is also found in practice. In a supply constrained closed economy, on the other hand, higher growth can lead to reduced inflation (Dholakia R. H., 1990). Thus, the relationship between growth and inflation may also be bi-directional. This ambiguous relationship between inflation and growth implies that though rising inflation may have associated growth costs, policy efforts to contain inflation could negatively affect growth. On the other hand, allowing inflation at higher rates could lead to higher growth although it may cause some distorted choices. Relationship between inflation and savings is critical in understanding this complex trade-off between growth and inflation particularly for the policy makers.

Growth, savings and inflation are interrelated variables as discussed above and should, therefore, be endogenously determined simultaneously in the system. However, most of the studies on these variables do not analyze them in a simultaneous equation framework. It is important for a policy maker to understand the dynamics among economic growth, savings and inflation in the system. Specifically, answers to the following questions are crucial: (i) Is there simultaneity between economic growth and savings? (ii) Is the relationship between economic growth and inflation bi-directional or unidirectional? (iii) What is the direction of causality, sign and magnitude of relationship between these variables? The present paper tries to examine these questions in a simultaneous equation framework for 13 south-east and south Asian economies for the period, 1989 to 2003. The selected sample shows wide variations among all these variables not only across countries but also over time within a country. The panel data analysis used in the current study would overcome several limitations of the empirical evidences presented earlier.

In what follows, Section 2 outlines the theories and empirical results discussing channels through which economic growth and inflation, and savings and inflation are inter-related. Section 3 deals with the conceptual framework and regression model, detailing upon the various other predictor variables as well as the functional form used in this paper. Section 4 discusses some statistical issues in estimation. Section 5 presents and analyzes the results of the regression

model with focus on economic growth, inflation, and savings and their inter-relationship with each other. The individual country and year effects are also discussed in this section. Finally, section 6 concludes and discusses some policy implications arising out of the study.

2. Inflation with Growth and Savings: Theory and Empirical Evidence

Growth and Inflation

There are broadly two types of theoretical expectations concerning the effect of change in average inflation level on output growth (Chari et al., 1996). One expectation, based on exogenous growth models, is that inflation rate will have no effect on the growth rate as well as the level of output. As opposed to this, the endogenous growth models emphasize that money and inflation do affect the growth rate of output itself. There are two channels for such an effect. One argument is known as the Mundell-Tobin effect in which a more inflationary policy enhances growth as investors move out of money and into growth enhancing capital investment. This is because inflation reduces the wealth of people, and for accumulating the desired wealth, people save more, decreasing real interest rate and driving up capital accumulation (Haslag, 1997). It is possible, however, to argue that inflation in such a case would affect savings and investment decisions essentially by increasing the uncertainties with regard to the real rates of return. This can actually reduce the productive capital and hurt the output growth (Motley, 1994; and Miller and Benjamin, 2008).

The structural argument, on the other hand, emphasizes that inflation promotes real growth. There are two possible justifications stemming from two schools of thoughts- (i) in fixed prices Keynesian economies, inflation can induce growth by redistributing profits from workers with low saving propensities to entrepreneurs with high propensities to save and invest, and by increasing the nominal rates of return relative to the cost; and (ii) in economies with flexible prices, inflation can redistribute money from holders of money balance to the monetary authorities, a phenomenon also known as inflation tax that helps governments to expand their investment programs and thereby increase growth. As against this, the alternative view is that inflation retards growth. The arguments supporting this view are that: (i) high inflation rates raise the cost and risk of productive capital, and may lead to misallocation of funds to less productive investments that act as a hedge against inflation (Chopra, 1988); and (ii) high inflation rates along with managed exchange rates lead to trade imbalances and speculative capital outflows affecting the economy's growth (Paul et al., 1997). Gillman and Kejak (2002) find the negative relationship between inflation and growth. Roubini and Sala-i-Martin (1992), on the other hand, argue that the findings by various studies about the negative link between inflation and growth, if not carefully established, can be spurious since both high inflation and low growth are often caused by the policies of financial repression.

Most of the studies examining the relationship between inflation and growth end up focusing on the effect of inflation on savings and investments and thereby on the growth of the economy, assuming independence of the incremental capital output ratio (ICOR) from inflation. Except Chopra (1988), the ICOR channel of the effect of inflation on growth is not seriously examined in the literature. Thus, if inflation leads saving rate to increase and ICOR to decrease, inflation will definitely promote growth, but the reverse would be true if saving ratio decreases and ICOR increases with inflation. If both these variables increase or decrease

simultaneously as a result of inflation, the magnitude of the statistical impact of inflation on these two variables would determine the sign of the relationship between inflation and growth. Chopra (1988) argued that inflation would affect the ICOR by changes in the composition of output produced as a result of households shifting from financial savings to physical savings or consumer durables in an economy. This would lead to shifts of investment from low capital intensive industries to high capital intensive industries, increasing the capital output ratio in the economy. Thus, inflation is likely to increase the ICOR.

Savings and Inflation

The effect of inflation on savings depends on the way households react to increase in inflation (Chopra, 1988). If households direct their savings from financial to physical assets and consumer durables, then due to consumption associated with these consumer durables, present savings will decline. Also, due to increased uncertainty, the utility from holding wealth declines leading to increased consumption and decreased savings. On the other hand, wealth owners interested in maintaining the real value of their wealth would increase their savings in an inflationary scenario to maintain the desired amount. In the context of the life cycle theory of savings, if the economy does not have a detailed and well established institutional structure or network for social security, healthcare, etc., inflation would induce higher savings in the system (Chopra, 1988).

Most of the models analyzing the effect of inflation on savings find a considerably negative effect (Heer and Suessmuth, 2006). If the incomes are not indexed, unanticipated inflation will cause unanticipated cuts in the real income and hence decreased the saving rates (Deaton, 1977). Also, high inflation can increase the opportunity cost of holding money and increase the rewards for the search activities in shopping wasting real resources and thereby reducing savings (Miller and Benjamin, 2008). As against this, another theory proposes that if the real income is correctly anticipated either by indexation or wage inflation, unanticipated inflation will increase the saving rate. Inflation is a good proxy for macroeconomic uncertainty. Higher uncertainty induces people to save a larger portion of their money for precautionary motives. Thus rise in inflation should have a positive coefficient. Savings will also increase if there are lifecycle factors promoting savings (Deaton and Paxson, 1993). If, however, one believes in the super-neutrality of money in the ultimate sense, inflation cannot have any effect on savings in the long run (Heer and Suessmuth, 2006).

3. Conceptual Framework

Apart from the saving rate and inflation, there are demographic variables also which have been found to be instrumental in affecting the growth rate. Bloom et. al. (1999) emphasize the importance of ‘age structure’ on the economic growth. Age structure implies the distribution of population amongst various age categories. The people falling in working age group earn for the old people and the children, who can be categorized as dependents. The ‘dependency ratio’, signifying the proportion of population dependent on the working age persons can be a very important factor affecting the saving rate and also the economic growth of a country, if accompanied by increasing labor productivity. Adult literacy rate is a reflection of better human capital and hence higher labor productivity.

In the increasingly globalised world, trade has become one of the most important sources of growth and efficient allocation of resources. The degree of openness hence becomes very important for a country's growth. Similarly, the convergence hypothesis suggests that the level of GDP would determine whether the country will grow at a high or a low rate (Barro and Sala-i-Martin, 1995). Many models of growth neglect monetary variables and include only the real variables. However, this is justified only if the monetary variables have no effect on the real variables of the system, i.e. neutrality of money, a concept which has been debated for long (Sidrauski, 1967). The impact of money growth on the output growth is modeled through inflation (Paul et al., 1997).

Savings are affected by many variables, the prominent being income, real rates of return, inflation, as well as demographics (Loayza et al., 2000). Savings is dependent on the level of income as well as the growth of income. In the determination of inflation, along with money supply growth, past values of inflation as per the adaptive expectations hypothesis are also considered. In the formulation of our regression model, money supply is included in the equation for inflation and not in the growth equation. This is because inflation is explicitly considered in the growth equation where the production function approach using money as an input augmenting variable is not appropriate.

3.1 Functional Form

Regarding choice of the functional form, especially for inflation, there have been many different forms used, varying from simple inflation to log of inflation, to log of '1 + inflation'[5]. The problem with log form is that it is undefined for negative values and '1+log' is arbitrary. Using the inflation rate straight away could be problematic if there are high inflation rates present in the data because the distribution could, then, be skewed, which can be normalized by using the log transformation (Gillman et al., 2001). In another study (Loayza et al., 2000), the inflation rates more than 50% have been eliminated to avoid such problems. However, in our case, it was found that not many observations of inflation were above 50% and hence there was no need for any kind of transformation.

The model being estimated is -

*Per Capita Real GDP Growth Rate = a1 + b1 * Log Per Capita Real GDP with Lag + c1 * Inflation Rate + d1 * Saving Rate + e1 * Openness Ratio + f1 * Population Growth Rate+ g1 * Dependency Ratio + h1 * Adult Literacy Rate + i1 * Nominal Depreciation Rate + error* ---------- *(1)*

*Saving Rate = a2 + b2 * Log Per Capita Real GDP + c2 * Per Capita Real GDP Growth Rate + d2 * Real Interest Rate + e2 * Inflation Rate + f2 * Dependency Ratio + error* ---------- *(2)*

*Inflation Rate = a3 + b3 * Money Supply Growth Rate + c3 * Per Capita Real GDP Growth*

[5] There is however a different interpretation and effect of using the log versus linear model. In the linear model, additive inflation shocks will have same effect on all rich or poor economies, whereas in the log model multiplicative inflation shocks will have the same effect on all economies. E.g. in the linear model, an increase in the inflation rate by say 5% will have the same effect on two economies in which one is at an initial inflation level of 10% while the other is on 50%. But as per the log model, only doubling the inflation rate will have the same effect on growth of two economies at a very different level of inflation (Khan and Senhadji, 2001).

*Rate + d3 * Inflation with Lag + e3* Nominal Depreciation Rate + error*
---------- (3)

There are three equations in this system and there are interrelationships between the three variables- per capita real GDP growth rate, saving rate and inflation rate. The model involves presence of simultaneous effect between per capita real GDP growth rate and saving rate, per capita real GDP growth rate and inflation rate.

3.2 Data and Variables

The study is based on the developing countries pursuing the policies to achieve rapid growth from the south-east and south Asia region. The choice of the countries was also restricted by availability of required data on all variables over the selected period. There are 13 countries satisfying these criteria from the region for 15 years, i.e. from 1989 to 2003. The following countries are considered - Bangladesh, China, Hong Kong, India, Korea, Malaysia, Maldives, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, and Thailand. Indonesia, although a large economy in the region, has not been included due to unavailability of reliable estimates of some variables, specifically dependency ratio and adult literacy rates. The figures for per capita real GDP and its growth have been taken from Penn World Tables, while all the other data, excluding dependency ratio and adult literacy rate, have been taken from the Asian Development Bank. The dependency ratio and adult literacy rate values have been taken from various census estimates for different countries, as well as UNICEF and World Bank statistics. The missing values (especially in dependency ratio and adult literacy ratio as these statistics are mostly calculated with a gap of a few years) have been substituted after studying the trend

Table 1: Basic Statistics

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
Pcrgdpgr	Per capita real GDP growth rate (%)	195	3.09436	4.10254	-9.44	15.22
Logpcrgdp	Log per capita real GDP	195	3.60786	0.41312	3.043684	4.468846
logpcrgdplag	Log per capita real gdp lag	195	3.59497	0.41191	3.029704	4.468846
openratio	Openness ratio (%)	195	106.921	87.0408	15.3896	319.7935
monsupgr	Money supply growth rate (%)	195	16.2454	12.3655	-2.72454	153.29
exchrategr	Nominal exchange rate growth rate (%)	195	4.86051	9.01451	-15.1715	49.58
depratio	Dependency ratio (%)	195	62.9692	17.1887	37	100
Popgr	Population growth rate (%)	195	1.76607	0.85355	-3.31649	4.1
adlitrate	Adult literacy rate (%)	195	75.5943	23.2463	28.81	97.21
rlintrate	Real interest rate (%)	195	2.03746	4.15533	-18.5883	9.75869
Savrate	Saving rate (%)	195	28.6764	12.4417	7.874023	51.75015
Inf	Inflation rate (%)	195	6.03261	4.8723	-3.95869	24.08829

Source: See the Text.

of the variable for that country. If the trend is increasing or decreasing, missing values have been computed by extrapolation assuming constant growth or decline. In case the trend is fluctuating, the missing values have been replaced by the mean. Table 1 shows the basic statistics of the variables.

Percentage change in consumer price index has been taken as inflation. Gross domestic savings figures have been used for saving rate. Money supply growth is the growth in M2 stock of the country. Real interest rates have been calculated by subtracting inflation (CPI) from the interest rate on demand deposits of 12 months as end of period. For China, CPI has been subtracted from interest rates on borrowings from the external sector (due to unavailability of interest rates on demand and other deposits). Openness ratio is the sum of exports and imports over GDP. Dependency ratio is the number of persons under age 15 and over age 65 per 100 of those aged between 15 to 64 years. Adult literacy rate implies percentage of persons aged 15 and over who can read and write. Exchange rate is in nominal terms and is the yearly average of local currency value of dollar. Depreciation rate is the growth rate of the so-defined exchange rate. All the values are in percentage terms instead of ratios.

4. Estimation Issues

The model involves three simultaneous equations which have been jointly estimated using a 2SLS estimation procedure. The choice between fixed and random effects model for analyzing the panel data, and tackling the auto-regression bias has been explained below. Finally, the question about the presence of multi-co-linearity affecting estimates of the model is also addressed.

4.1 Pooled v/s Individual Effects

Panel data consisting of 13 countries of Asia for 15 years, from 1989 to 2003 has been used in the study. The regression model can assume that there are individual country and time effects present, or these effects are absent in the data. If these effects are missing, then a simply pooled regression would be appropriate for finding parameter estimates. For selecting between pooled and individual fixed effects, an Incremental F test was performed which has null hypothesis that parameters obtained from pooling are more efficient than fixed effects model. It indicates the model selection between pooling regression and fixed effect model. The following table exhibits the test results-

Table 2: Test Statistics of Pooled versus Fixed Effects

F Test for No Fixed Effects					
		Numerator Degree of Freedom	Denominator Degree of Freedom	F Value	Pr > F
Growth	One way	12	174	8.53	<.0001
	Two way	26	160	4.97	<.0001
Inflation	One way	12	178	0.56	0.8709
	Two way	26	164	1.96	0.006
Saving	One way	12	177	232.14	<.0001
	Two way	26	163	105.11	<.0001

The test supports two-way fixed affect specification for all the three equations over the pooled regression specification.

After rejecting the pooled regression specification, the choice is between a fixed effects model and a random effects model[6]. In a growth model, it is expected that the unobserved effects might be correlated with the included variables, which will bias any random effects approach (Gillman et al., 2001). Also it is interesting to analyse if some of the countries have an innately higher/lower growth rate and if there is any year effect across all countries. Random effect Hausman test (Breusch-Pagan LM test) has been used, which has null hypothesis that the random effect estimators are more efficient than fixed effect model. The one way and two way effect for both fixed as well as random effect models were tested for all the three equations. Results of the test are presented in the following table-

Table 3: Hausman Test for Random Effect

Hausman Test for Random Effects				
		DF	**Hausman m Value[7]**	**Pr > m**
Growth	**One way**	6	31.27	<.0001
	Two way	8	37.4	<.0001
Inflation	**One way**	4	5.9	0.2066
	Two way	4	20.85	0.0003
Saving	**One way**	--	--	--
	Two way	5	1.73	0.8853

Thus the test results support two way fixed effects approach for two equations in the system (growth and inflation) and random effect for one equation (saving rate). On the basis of theory and test results, the study uses 'fixed-effects model' to estimate the parameters for all the three equations in the model. Intercept coefficients for individual countries and years have been estimated.

4.2 Removing Auto-regression Bias

The inflation model consists of an auto-regressive term, the last year's value of inflation. Regressing inflation on its one year lag can lead to biased estimates. Since the model has simultaneity, this bias can affect the significance level as well as parameter estimates of the other two equations as well, which have inflation as an explanatory variable. To remove this bias, the auto-regressive variable has been replaced by an instrument. The instrument used in this case is the difference in current value of inflation and its one year lagged value. This instrument was checked for its degree of correlation with the auto-regressive term, and the degree of correlation was found to be substantially high. Also, there is no theoretical reason to believe that this instrument will be correlated to the error term in the equation.

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[6] The choice between estimating the model through the fixed effects (FEM) approach or the random effect (REM) approach depends on the expected correlation between the observed and unobserved heterogeneous terms. REM is more efficient than FEM as it models the many intercepts as two stochastic terms, but it can yield biased estimates in case the characteristics modeled by the error components are correlated with the explanatory variables. This correlation might be due to natural resources or simply attitudes towards work (Kelley and Schmidt, 1995). Also, a *priory*, it can be said that, since the countries differ significantly, individual time invariant country effects will be present in any such analysis.

[7] Refer Green (2003) for a detailed exposition on Hausman test and Hausman m-statistic

4.3 Presence of Multicollinearity Effects

The pair-wise correlation matrix for the variables used in the study is presented in Appendix 1. The correlation between Log per capita real gdp lag and Openness ratio is 0.9, which may cause multicollinearity. This effect is found in the Variance Inflation Factor (VIF) of the estimates. The VIF factor of parameter estimates is high for Per Capita Real GDP Growth Rate Model only. Savings rate and Inflation Model are approximately free from multicollinearity. VIF factor is high because of inclusion of country and year dummies (Fixed effect Model, confirmed by Hausman's specification test). This has been found by removing the dummies from the Per Capita Real GDP Growth Rate Model and estimating the parameters. Multicollinearity may affect the significance of the estimates; but the parameter estimates will be unbiased and efficient. The VIF of the parameter estimates reduces drastically once the dummies are removed, however, we do not find any change in significance level. In the Per Capita Real GDP Growth Rate Model most of the parameters estimates are highly significant (0.1% significance level, presented in Table 4). In this situation when R-square is high and regression coefficients are individually significant as revealed by the higher t-values, then multicollinearity may not pose a serious problem (Gujarati, 2004). Hence the parameters estimates of the Growth model are stable even after inclusion of dummies and dummies are important because by the use of dummies we are controlling for country and year effect.

5. Results and Discussions

The results show that the model fits given data extremely well with the R-square values of 88.9%, 70.8%, and 97% for respectively the growth, inflation, and saving rate equation in the structural form. The structural form parameters give only partial impact of the pre-determined variables on the endogenous variables. In the simultaneous equation framework, the total impact of a predetermined variable is measured by the impact parameter coefficient corresponding to the variable in the reduced form of the model. Depending on the model and the sample, the total impact parameter can be different from the partial impact parameter as obtained from the structural model. It is possible that even the sign of the two impacts may turn out different. However, in our model and sample, the results show the same sign but substantially different magnitudes in a few cases. We therefore, first discuss the structural form estimates and then consider the total impact parameters.

5.1 Examining Economic Growth

All the variables explaining growth are coming out to be highly significant. Table 4 shows the parameter estimates of the explanatory variables.

The positive sign of *log per capita GDP lag* values indicates that the convergence hypothesis is rejected by the south-east Asian economies, contrary to the findings of Khan and Senhadji (2001) who obtained convergence after including a wide range of countries. The relationship with *saving rate* is highly significant with high magnitude (+1.25) implying that saving rate is an extremely important variable through which growth rates can be affected. This is similar to what has been found by Loayza et al. (2000) who argue that income growth through savings accrues mostly across cohorts. This result is in complete agreement with Deaton and Paxson (1993) who found broad patterns of East Asia's economic growth as

exhibiting high rates of economic growth accompanied by high saving rates.

Table 4: Structural Form Parameter Estimates of Per Capita Real GDP Growth Rate

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	34	2904.09526	85.41457	37.85	<.0001
Error	160	361.08634	2.25679		
Corrected Total	194	3265.18159			

Dependent Variable = Per Capita Real GDP Growth Rate				
R-Square = 0.8894 **Adj R-Sq =** 0.8659				
Variable	**Label**	**Parameter Estimate**	**Standard Error**	**Pr > |t|**
Intercept	Intercept	-40.27195	9.92217	<.0001
Logpcrgdplag	Log per capita real gdp lag	12.0718	2.73246	<.0001
Openratio	Openness ratio (%)	-0.1342	0.01008	<.0001
Depratio	Dependency ratio (%)	0.21123	0.05234	<.0001
Popgr	Population growth rate (%)	-2.93579	0.24296	<.0001
Adlitrate	Adult literacy rate (%)	-0.22602	0.06912	<.0013
Exchrategr	Nominal exchange rate growth rate (%)	0.28413	0.02302	<.0001
Savhat	Saving rate (%)	1.25488	0.05256	<.0001
Infhat	Inflation rate (%)	-1.89668	0.0973	<.0001

Highly significant and negative sign of *inflation rate* parameter (-1.89) shows that there are huge growth costs associated with inflation, an evidence supporting the findings by Gillman and Kejak (2002) and Heer and Suessmuth (2006). High inflation in Asia may increase the cost and risk of productive capital and may lead to misallocation of funds as argued by Paul et al.(1997). Inflationary finance may also be hence welfare and growth reducing as argued by Aghevli(1977) and Motley(1994). This relationship is what is being currently observed in India and some other countries where higher predictions of inflation have led to decrease in future growth forecasts. The evidence hence stands in contrast to the Mundell-Tobin effect and the structural argument, both of which propose that an inflationary policy promotes real growth, although through different mechanisms.

Positive and significant relationship with *nominal depreciation rate* also implies that with increase in the growth rate of exchange rate (i.e. depreciation of the home currency), economic growth will be boosted. This is because depreciating exchange rate leads to higher gains from exports and hence higher GDP. This finding supports the one by Kaplan (2006), who finds that undervalued exchange rate has helped promote an export led growth in China as well as other East Asian economies. Increase in population growth puts pressure on the resources of a country, pulling down the growth rates, as being indicated by the highly significant negative value of its parameter. This is contrary to the finding of Bloom et al. (1999), who show that population has an insignificant effect on economic growth. Dependency ratio

parameter has a positive sign in the growth equation, signifying higher labor productivity in countries with higher dependency ratio. This is possible if in the south and east Asian countries higher dependency ratios are associated with higher life expectancy and better health status of the population (Tuljapurkar, 2002), as is the case with OECD economies (Jacobzone et. al., 2000).

In the present study, openness is proxied by the ratio of exports plus imports to GDP. This measure, though an imperfect substitute of openness as it reflects many other factors also other than trade and trade barriers, has been used widely in many studies (MacDonald and Ricci, 2003; Suryahadi et al., 2001). The negative sign of openness ratio, as found in the present study, though counter-intuitive, is strongly supported by an important study (Rodriguez and Rodrik, 2001), which shows that openness in the sense of liberal trade policies which support higher growth rates, is no guarantee of faster growth. The study criticizes the large number of studies exhibiting positive relationship between openness on growth on methodological grounds. A very recent UN/DESA working paper (Rodriguez, 2007) also discusses the 1990-2003 experience around the world and shows that growth does not display a significant correlation with any measure of trade openness over this period. This study cites some interesting examples, e.g. Lebanon and Lesotho can not be classified as open economies based on trade ratio and tariff criteria, but Lebanon had the third highest growth rate and Lesotho had sixth largest growth rate of per capita incomes in the world between 1990 and 2003. Similarly there are slowest growing economies like Moldova and Mongolia, which are highly open. Hence, both the fastest and the slowest growing economies in the world constitute both open and closed economies, which might explain the negative coefficient sign for openness.

The counter-intuitive negative sign of adult literacy rate in growth equation can make sense when analysed in conjunction with the result of another study, which concludes that it may take about seven to nine years for the positive effects of adult literacy to be felt on the growth (Dholakia, 2003). Hence, adult literacy may positively affect growth, but only with a substantial time-lag. The negative sign could be present in the short run, because focusing on adult literacy rate would lead to diversion of substantial amount of resources devoted for increasing literacy rates and education from their immediately productive uses. But, investing in increasing literacy rate and education is a social sector investment and will have significant positive returns only in the long run (Dholakia A., 1990). This counter intuitive sign could be on account of the special characteristics of the south-east Asian economies. On an average, all these economies can be considered as developing economies and not as developed ones, especially during the period of the study. The literacy rates on an average are low and hence increasing these are an important social sector priority for most of these governments.

5.2 Examining Savings

Saving rate is highly significantly affected by the log of per capita real GDP. This provides support to the standard Keynesian theory that as the per capita real income rises saving rate would also rise. Table 5 shows the parameter estimates.

The results also show that the per capita real GDP growth rate also significantly and positively affects the saving rate. Thus along with higher income, at higher growth rate of income, too, the saving rate is higher. The effect of dependency ratio is statistically insignificant but the negative sign provides support to the findings of Loayza et al. (2000) about the lifecycle

Table 5: Structural Form Parameter Estimates of Saving Rate

Analysis of Variance					
Source	DF	Sum of Squares	Mean Squares	F Value	Pr > F
Model	31	29152	940.40109	174.59	<.0001
Error	163	877.95049	5.3862		
Corrected Total	194	30030			
Dependent Variable = Saving Rate					
R-Square = 0.9708 Adj R-Sq = 0.9652					
Variable	Label		Parameter Estimate	Standard Error	Pr > |t|
Intercept	Intercept		-29.59898	13.60293	0.031
Logpcrgdp	Log per capita real GDP		15.35819	3.68027	<.0001
Depratio	Dependency ratio (%)		-0.06383	0.07007	0.3637
Rlintrate	Real interest rate (%)		-0.06358	0.05421	0.2426
Infhat	Inflation rate (%)		0.08673	0.08797	0.3256
Gdphat	Per capita real GDP growth rate (%)		0.14053	0.0543	0.0105

theory that, as dependency ratio increases, saving rate would decrease. The insignificant parameter of real interest rate rejects the classical theory of positive relationship of savings with real interest rates. This is contrary to the finding of Athukorala and Sen (2004) who found a positive impact of the real interest rates on the savings in India. This is perhaps because they did not adjust for the simultaneity bias. Inflation is also found positively but statistically insignificantly related to savings in the present study. This is contrary to the findings of Chopra (1988) who obtained a significant positive impact of inflation on savings in the case of the Indian economy prior to 1982. The positive inflation coefficient can be explained in terms of the people wanting to preserve the real value of their wealth in presence of inflation, perhaps because the social security and health concerns are not adequately addressed by the existing institutional network in these countries. As a result, the inflation induced increased macroeconomic uncertainty forces people to save more. This is contrary to the findings of Heer and Suessmuth (2006).

5.3 Examining Inflation

The lagged value of inflation (instrumented by using the difference between present and last year's value of inflation) has a positive and highly significant relationship with inflation. Since this lagged value has been taken as a proxy of inflationary expectations, the result supports the adaptive inflationary expectations hypothesis. Evidence suggests that inflationary expectations are extremely important in predicting future values of inflation, as discussed by Sidrauski (1967). The detailed parameter estimates for inflation rate are given in Table 6

Money supply growth does not turn out to be statistically significant even at 10% level in affecting the inflation rate. The sign of the parameter is, however, positive as expected. This result is in agreement with Saini (1982) who also found that money stock growth was not the

Table 6: Structural Form Parameter Estimates of Inflation Rate

Analysis of Variance					
Source	DF	Sum of Squares	Mean Squares	F Value	Pr > F
Model	30	3261.9049	108.73016	13.27	<.0001
Error	164	1343.5236	8.19222		
Corrected Total	194	4605.4285			

Dependent Variable = Inflation Rate				
R-Square = 0.7083	Adj R-Sq = 0.6549			
Variable	Label	Parameter Estimate	Standard Error	Pr > |t|
Intercept	Intercept	6.59268	1.14661	<.0001
Infdif	Instrument for lagged inflation (%)	0.45684	0.05626	<.0001
Monsupgr	Money supply growth rate (%)	0.02954	0.01967	0.1351
Exchrategr	Nominal exchange rate growth rate (%)	0.09226	0.02908	0.0018
Gdphat	Per capita real GDP growth rate (%)	-0.03577	0.06688	0.5935

primary source of inflation for some Asian countries. Similarly, per capita real GDP growth rate is also not statistically significant in predicting the inflation rate. Thus, the experience of the south and east Asia does not support the prediction of quantity theory of money even at 10 per cent level of significance. This contradicts R. H. Dholakia (1990), who in his analysis of India found strong support to the quantity theory and hence recommended that high growth of income would tackle the problem of high inflation. In the present study, exchange rate depreciation is highly significantly and positively related to inflation rate. This supports the findings of Honohan and Lane (2004) for Ireland. This finding is all the more plausible because most of the countries in our sample are net importers of oil.

5.4 Simultaneity Evidence

The regression model was based on the hypothesis that there is a simultaneous relationship between growth and savings and between growth and inflation. A simultaneous relationship has been found between growth and savings, with both significantly and positively affecting each other. The effect of savings on growth is much higher (parameter estimate equal to 1.25) as compared to the effect of growth on savings (parameter estimate equal to 0.14). On the other hand, the evidence from Asia rejects the hypothesis of a two-way relationship between growth and inflation. Thus inflation affects growth in a highly negative way (-1.89), but growth does not affect inflation (though the parameter is negative (-0.03)). On the other hand, inflation does not affect the saving rate (though the parameter is positive at 0.087). These two findings together imply that inflation must have a substantially positive effect on ICOR providing support to Chopra' (1988) hypothesis about inflation leading to shifts in production structure from less capital intensive to more capital intensive goods ultimately resulting in raising ICOR.

5.5 Impact Parameters

Impact parameters, which refer to the total net effect of exogenous (or pre-determined) variables on the endogenous variables, are presented in Table 7. When compared to the coefficient estimates in Tables 4, 5, and 6 it is clear that the direction of the impact as given by the

sign of the coefficients has not reversed in any of the three endogenous variables. Thus the presence of simultaneity has not totally altered the direction of results in our case. For several variables, however, the magnitude of the impact has substantially changed. The change in the magnitude of the impact is in both the directions. For openness ratio and adult literacy rate, there is a sharp increase in their impact on the growth, whereas dependency ratio, population growth and depreciation rate experience a sharp decrease in their impact on growth rate when simultaneity is considered. Similarly in the case of the saving rate, while the impact of the level of GDP substantially increases, that of the dependency ratio sharply falls when simultaneity is considered. For inflation rate, however, the impact parameters in the structural form and the reduced form differ only marginally.

Table 7: Impact Parameters

	Real GDP Growth Rate	Saving Rate	Inflation Rate
Log Per Capita Real GDP Lag	15.88782549	2.18342679	-0.56830388
Openness Ratio	-0.17111991	-0.02351661	0.00612092
Dependency Ratio	0.17731605	-0.03563187	-0.0063426
Population Growth Rate	-3.85677951	-0.53002821	0.13795612
Adult Literacy Rate	-0.28958754	-0.03979734	0.01035848
Nominal Depreciation Rate	0.15676446	0.02934996	0.0843925
Log Per Capita Real GDP	25.35523745	18.8345114	-0.9069394
Real Interest Rate	-0.09910842	-0.07362024	0.00354504
Inflation Lag	-1.0590075	-0.106506	0.4878801
Money Supply Growth Rate	-0.0706005	-0.0071004	0.03252534

Comparing these net effect estimates with the estimates of the regression parameters, we do not observe substantial difference in the effect of almost all the predetermined variables. The positive direct effect of nominal exchange rate depreciation on the GDP growth rate decreases from .28 to .15 on the account of its indirect negative effect through inflation. The negative effect of population growth on GDP growth increases on the account of interplay between the exogenous variables. Apart from these, the changes in the effects of all the exogenous variables on the three endogenous variables are only marginal.

5.6 Country and Year Specific Effects[8]

Country Effects

There are no country specific effects for explaining per capita real GDP growth rate, but in case of inflation rate and saving rate, many countries exhibit individual effects which were modeled as fixed effects in the panel data framework. Bangladesh is taken as the reference country and all the analysis is done with reference to this country. India, Philippines, Singapore and Sri Lanka show presence of time invariant fixed effects influencing both saving rate and inflation rate. Pakistan, and Nepal show individual fixed effects influencing only

[8] The detailed estimates for individual country and year effects are given in the Appendix

inflation rate while China, Korea, Malaysia, Thailand and Maldives all exhibit individual fixed effects influencing only saving rate.

China, India, Malaysia, Korea, Maldives, Singapore and Thailand exhibit positive individual effect on saving rate, while Philippines and Sri Lanka show negative fixed effect on the saving rate. The magnitude of positive fixed effect of China, Korea Malaysia, Maldives and Singapore on saving rate is particularly very high, which is expected given the policies favoring high saving rate adopted in these East Asian countries. In case of inflation, India, Pakistan, Nepal, Sri Lanka, and Philippines all show positive individual fixed effects while Singapore has a negative fixed effect on inflation.

Year Effects

As contrary to the time invariant country fixed effects, there is no country invariant year fixed effect on saving rate, while there is highly significant negative effect on growth as well as inflation. 1989 is taken as the reference year and all the analysis is done with reference to this year. This effect is exhibited consistently from 1998 to 2003 and is negative in all the cases. This highly significant negative year effect can be strongly related to the East Asian financial crisis which started in mid 1997 and affected many economies, particularly in Asia. This crisis mainly affected South Korea, Thailand, Hong Kong, Malaysia and Philippines and affected the other south-east Asian countries to a lesser degree. The currency rates, stock markets and asset prices were affected in many of these countries which can be assumed to have an impact on the inflation as well as growth rates of most of the Asian economies, as revealed by the data.

6. Concluding Remarks

There are two broad types of learning we have from the exercise carried out in the present study: (i) methodological and (ii) related to development policy arising from the experience of the south and south-east Asian countries. Most papers in the literature so far have analyzed the determinants of growth and savings separately. Few attempts have been made to analyze these variables in a simultaneous equation framework. The simultaneous effect of inflation on both economic growth and savings has also not been examined so far in a comprehensive framework. On the other hand, there are not only solid theoretical reasons to believe that these variables are determined simultaneously, but also that savings and inflation are very instrumental in the growth and economic development process of emerging economies. The most relevant finding of the present paper from the methodology angle is that growth and saving rate has bi-directional simultaneous relationship. Although we found only unidirectional relationship between inflation and growth in our sample, it is important to model it in simultaneous equation framework to avoid errors arising out of ignoring the simultaneity bias. Similarly, inflation was not found to affect the saving rate in our sample, but it needs to be considered while examining the interrelationships among growth, savings and inflation. The present study attempted to address this methodological issue and thereby the methodological limitations of earlier studies on the subject. With widely varying macroeconomic factors affecting economic growth, south-east and south Asian economies provided an interesting ground to analyze these relationships.

From the viewpoint of the development policy, our finding of a bi-directional relationship between savings and growth is important. Savings is not an end it itself. It is only a means to achieve high income growth and improved standards of living. Policies focusing on increasing the saving rates need to be followed, which can lead to higher growth rates and higher per-capita income. Both will, in turn, reinforce the higher saving rate. The magnitude of the effect of saving rate on growth is found to be substantially higher than the one of growth on saving rate and hence policies to promote savings are very important for promoting development. This approach seems to have been followed by many East Asian economies as reflected in the highly significant positive country effects exhibited for those economies in our study. These countries have high saving rates averaging around 40% of GDP leading to highly positive effects on their growth rates. The positive and significant effect of GDP level and GDP growth on the saving rate as per the standard Keynesian theory, found in our study, is consistent with the findings of Morande (1998) in the case of Chile and Athukorala and Sen (2004) in the case of India.

The most relevant finding from the policy perspective is the significant negative effect of inflation on the economic growth, which is unidirectional, i.e. economic growth does not affect inflation. The negative effect of inflation on growth was found in the case of Mexico (Grier and Grier, 2006) as well as Nigeria (Fabayo and Ajilore, 2006). High inflation in Asia may increase the cost and risk of productive capital and may lead to misallocation of funds as argued by Paul et al. (1997). The evidence stands in contrast to the Mundell-Tobin effect and the structural argument, both of which propose that an inflationary policy promotes real growth. Thus, controlling inflation and thereby providing macroeconomic stability is very essential for promoting growth in the economy. Inflation is also found positively but statistically insignificantly related to savings. Thus, there is an indirect evidence of inflation affecting the ICOR positively that supports the hypothesis propounded by Chopra (1988).

In the present situation of unprecedented rise in global commodity prices, the concern of the policy makers to control inflation is paramount. All developing countries targeting a high growth rate are grappling with this problem. Our findings from the data on south-east and south Asian countries reject the popular hypotheses that inflation is affected by economic growth and the growth of money supply. Therefore, the strategies of rapid economic recovery for effectively addressing the problem of high inflation in such countries (Dholakia R. H., 1990) and of controlling the growth of money supply propagated by IMF are not supported by the findings of this paper. The best way to curb inflation according to our findings on inflation equation is to control exchange rate depreciations and, if possible, directly influence inflationary expectations. However, when we consider the simultaneous framework, depreciation of exchange rate has the total net positive effect on growth and the net positive effect on inflation. Thus, there exists a clear trade off between growth and inflation in following any conscious exchange rate policy and the policy makers must exercise the choice cautiously.

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Appendix 1- Pair-wise Correlation Matrix

Correlation matrix of variables used in **Per Capita Real GDP Growth Rate Model**

	Log per capita real gdp lag	Openness ratio (%)	Dependency ratio (%)	Population growth rate (%)	Adult literacy rate (%)	Nominal exchange rate growth rate (%)	Saving rate (%)	Inflation rate (%)
Log per capita real gdp lag	1	0.907	-0.559	0.062	0.553	-0.286	0.678	-0.587
Openness ratio (%)	0.907	1	-0.419	0.170	0.560	-0.278	0.767	-0.601
Dependency ratio (%)	-0.559	-0.419	1	0.449	-0.515	0.166	-0.498	0.437
Population growth rate (%)	0.062	0.170	0.449	1	-0.236	0.001	0.029	-0.012
Adult literacy rate (%)	0.553	0.560	-0.515	-0.236	1	-0.204	0.791	-0.361
Nominal exchange rate growth rate (%)	-0.286	-0.278	0.166	0.001	-0.204	1	-0.295	0.600
Saving rate (%)	0.678	0.767	-0.498	0.029	0.791	-0.295	1	-0.339
Inflation rate (%)	-0.587	-0.601	0.437	-0.012	-0.361	0.600	-0.339	1

Correlation matrix of variables used in **Savings Rate Model**

	Log per capita real GDP	Dependency ratio (%)	Real interest rate (%)	Inflation rate (%)	Per capita real GDP growth rate (%)
Log per capita real GDP	1	-0.55838	0.001	-0.590	0.093
Dependency ratio (%)	-0.558	1	-0.056	0.437	-0.039
Real interest rate (%)	0.001	-0.056	1	-0.337	-0.017
Inflation rate (%)	-0.590	0.437	-0.337	1	-0.121
Per capita real GDP growth rate (%)	0.093	-0.039	-0.017	-0.121	1

Correlation matrix of variables used in **Inflation Rate Model**

	Instrument for lagged inflation (%)	Money supply growth rate (%)	Nominal exchange rate growth rate (%)	Per capita real GDP growth rate (%)
Instrument for lagged inflation (%)	1	0.001	0.197	-0.101
Money supply growth rate (%)	0.001	1	0.092	0.007
Nominal exchange rate growth rate (%)	0.197	0.092	1	-0.198
Per capita real GDP growth rate (%)	-0.101	0.007	-0.198	1

Appendix 2- Country and Year Effects for predicting Per Capita Real GDP Growth Rate

Dependent Variable = Per Capita Real GDP Growth Rate				
R-Square = 0.8894		Adj R-Sq = 0.8659		
Variable	Label	Parameter Estimate	Standard Error	Pr > |t|
C2	China	-3.47073	3.75479	0.3567
C3	HongKong	-0.91212	5.4509	0.8673
C4	India	-0.37474	1.43546	0.7944
C5	Korea	-3.92653	4.65671	0.4004
C6	Malaysia	-0.97745	3.90743	0.8028
C7	Maldives	-1.76821	4.00365	0.6593
C8	Nepal	0.35867	0.68061	0.5989
C9	Pakistan	0.7045	0.76779	0.3602
C10	Phillipines	0.66555	3.80909	0.8615
C11	Singapore	-1.33881	5.54763	0.8096
C12	Sri Lanka	2.19921	4.13759	0.5958
C13	Thailand	-2.80201	4.44369	0.5292

Reference Country: Bangladesh

Dependent Variable = Per Capita Real GDP Growth Rate				
R-Square = 0.8894		Adj R-Sq = 0.8659		
Variable	Label	Parameter Estimate	Standard Error	Pr > |t|
Y2	1990	0.33945	0.61111	0.5793
Y3	1991	-0.67104	0.60943	0.2725
Y4	1992	-0.38426	0.61936	0.5359
Y5	1993	-1.28789	0.64236	0.0467
Y6	1994	-1.11691	0.6677	0.0963
Y7	1995	-0.72403	0.71748	0.3144
Y8	1996	-0.74442	0.73546	0.313
Y9	1997	-0.91098	0.79489	0.2535
Y10	1998	-2.31127	0.86318	0.0082
Y11	1999	-2.38377	0.88593	0.0079
Y12	2000	-2.46381	0.96233	0.0114
Y13	2001	-4.07125	0.98567	<.0001
Y14	2002	-4.47773	1.05286	<.0001
Y15	2003	-4.90776	1.13283	<.0001

Reference Year: 1989

Appendix 3- Country and Year Effects for predicting Saving Rate

Dependent Variable =Saving Rate				
R-Square = 0.9708	Adj R-Sq = 0.9652			
Variable	Label	Parameter Estimate	Standard Error	Pr > |t|
C2	China	18.9991	2.17488	<.0001
C3	HongKong	-3.20833	4.78754	0.5037
C4	India	5.56245	1.16356	<.0001
C5	Korea	19.99009	2.23047	<.0001
C6	Malaysia	13.63454	2.8431	<.0001
C7	Maldives	25.13644	2.06154	<.0001
C8	Nepal	-0.42009	1.00097	0.6753
C9	Pakistan	-1.56973	1.14575	0.1726
C10	Phillipines	-3.53611	1.3428	0.0093
C11	Singapore	11.48214	4.76275	0.017
C12	Sri Lanka	-6.09647	1.92933	0.0019
C13	Thailand	7.44594	2.66178	0.0058

Reference Country: Bangladesh

Dependent Variable =Saving Rate				
R-Square = 0.9708	Adj R-Sq = 0.9652			
Variable	Label	Parameter Estimate	Standard Error	Pr > |t|
Y2	1990	-0.92283	0.9188	0.3167
Y3	1991	-0.50047	0.93278	0.5923
Y4	1992	-0.49658	0.94551	0.6002
Y5	1993	-0.54057	0.95364	0.5716
Y6	1994	-0.29384	0.97049	0.7624
Y7	1995	-0.38128	0.99904	0.7032
Y8	1996	-0.58453	1.01163	0.5642
Y9	1997	-0.23869	1.02833	0.8167
Y10	1998	0.82476	1.06321	0.439
Y11	1999	-0.4736	1.0998	0.6673
Y12	2000	-0.90594	1.12006	0.4198
Y13	2001	-1.95575	1.14787	0.0903
Y14	2002	-1.98926	1.19779	0.0987
Y15	2003	-1.5676	1.25229	0.2124

Reference Year: 1989

Appendix 4- Country and Year Effects for predicting Inflation Rate

Dependent Variable = Inflation Rate				
R-Square = 0.7083	Adj R-Sq = 0.6549			
Variable	Label	Parameter Estimate	Standard Error	Pr > |t|
C2	China	1.44581	1.14114	0.207
C3	HongKong	0.00328	1.05453	0.9975
C4	India	2.36161	1.05944	0.0272
C5	Korea	-0.59763	1.09293	0.5853
C6	Malaysia	-2.01147	1.0563	0.0586
C7	Maldives	0.69598	1.05973	0.5123
C8	Nepal	2.60204	1.05604	0.0148
C9	Pakistan	2.64527	1.05413	0.0131
C10	Phillipines	2.35942	1.05294	0.0264
C11	Singapore	-3.09247	1.05713	0.0039
C12	Sri Lanka	5.15829	1.05844	<.0001
C13	Thailand	-1.05442	1.05236	0.3178

Reference Country: Bangladesh

Dependent Variable = Inflation Rate				
R-Square = 0.7083	Adj R-Sq = 0.6549			
Variable	Label	Parameter Estimate	Standard Error	Pr > |t|
Y2	1990	-0.25678	1.13117	0.8207
Y3	1991	-0.02573	1.14651	0.9821
Y4	1992	1.29603	1.12526	0.2511
Y5	1993	0.00869	1.12643	0.9939
Y6	1994	-0.32365	1.12326	0.7736
Y7	1995	0.12358	1.13396	0.9134
Y8	1996	-0.588	1.12613	0.6023
Y9	1997	-1.96812	1.13326	0.0843
Y10	1998	-3.52182	1.20846	0.0041
Y11	1999	-3.1544	1.15424	0.007
Y12	2000	-5.31978	1.14516	<.0001
Y13	2001	-5.69175	1.15761	<.0001
Y14	2002	-5.0716	1.15122	<.0001
Y15	2003	-5.46418	1.14679	<.0001

Reference Year: 1989