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INFLATION AND OPENNESS: A STUDY OF SELECTED DEVELOPING ECONOMIES

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Foreword

The relationship between openness and inflation has been a subject of many studies, theoretical as well as empirical. Dr. Sunil Ashra began his research work on this project when he was at ICRIER from December 1999 to May 2001.

In an empirical analysis of 15 developing economies using panel data for the 1980s and the 1990s, he finds that besides the usual variables like the rate of growth of money and agricultural output, the openness variables such as export-to-GDP and import-to-GDP ratio also have significant influence on the domestic rate of inflation. He also finds that the impact of openness on inflation is affected by whether an economy is experiencing hyper-inflation and/or whether it is a large economy.

In any analysis of this type, questions can always be raised as to whether the "model" is fully specified, whether openness is "properly" measured, and therefore whether the relationship is properly captured. But the fact that the assumptions and definitions are clearly spelt out enables the results to be taken in the context of the framework of analysis. I am sure that this study will provoke further analysis to address some complex issues surrounding this important policy issue.

I must thank Dr. Ashra for taking time from his current assignment as a faculty member of the FORE School of Management to complete the work for this project that he had started when he was at ICRIER.

Isher Judge Ahluwalia
Director & Chief Executive

Inflation and Openness: A Study of Selected Developing Economies[1]

Sunil Ashra

I. Introduction

In today's world no developing country can afford to isolate itself from the world economy. The benefits of outward-looking policies that help in taking advantage of the possibilities of international trade and capital flows are extensively discussed in the literature. In the 1990s, economic liberalization, globalization and openness have become the buzzwords. There has been a distinct shift in favor of greater integration of the world economy. The trend has been towards greater opening up and there is evidently a move away from the typical closed economy structure in most of the developing economies. In this paper, an attempt will be made to examine the influence of openness on inflation using data for selected developing economies.

Inflation has obvious costs to an economic and social system. A high rate of inflation could lead to substantial resources being wasted in inefficient transactions and speculation, and it destroys the basis for rational economic decisions and damages the credibility of most of the government policies. Some characteristics of a properly functioning monetary economy are most vivid when we contrast it with a hyperinflationary situation in which money loses its usefulness (Krugman, 1991, p 77)[2].

Inflation also distorts the functioning of the price mechanism. The evidence from various studies on developing countries suggests that relative prices tend to become more volatile as inflation rises even where indexation is prevalent, partly because many governments attempt to protect certain segments of the population from inflation through selective price control measures. In addition, high inflation tends to be more volatile over time. The variability of inflation – both between sectors and over time – makes it difficult to plan ahead and diverts resources away from productive uses.

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[1] I am grateful to Dr. Isher Judge Ahluwalia for giving me the opportunity to work on this paper and providing insightful comments and suggestions. I am particularly thankful to Prof. K.L. Krishna and Dr. R. Kavita Rao for critical comments, suggestions and encouragement at various stages of completion of this paper. Important comments by Dr. Shankar Acharya, , Dr. Parthasarathi Shome, and Ms. Nisha Taneja are gratefully acknowledged and incorporated wherever feasible. All remaining errors, however, are mine.

[2] During hyperinflation the purchasing-power risk of nominal assets explodes, and the demand for those assets collapses. In particular, financial assets with interest rates that move sluggishly disappear from portfolios. Sellers may prefer to hold goods rather than market them. The German hyperinflation produced starving children in the cities while the farmers amassed stocks that they would not sell for meaningless cash (Okun, 1981, p 219). This happens because high inflation and inflation variability create uncertainty and undermine the confidence of domestic investors and foreign lenders. At very high levels of inflation, the economic horizon is shortened and financial instability disrupts economic decisions. High inflation is usually also a symptom of fundamental problems in macroeconomic management. While inflation persists, private sector investors will expect the government to be driven eventually to take corrective measures. The longer these are delayed, the more disruptive the effect on the economy.

It is sometimes argued that a moderately high rate of inflation is a necessary by-product or even a spur to development. Proponents of this argument point to structural rigidities in developing countries as the main source of inflation (Krugman, 1996; RBI, 2002)[3]. The solution, in their opinion, must be to tackle the root cause of the problem through structural measures. However, attempts to smooth out the development process by accepting inflation could be counterproductive with a potential risk of runaway inflation[4] (IMF, 1990, p 55) [5].

Fischer (1993) has reviewed extensively the evidence and presented his own empirical evidence, which supports the view that a stable macroeconomic environment, meaning a low rate of inflation and a small budget deficit, is conducive to sustained economic growth (p 509). His observations indicate that countries with low inflation have grown faster (south east Asian economies) and countries with high inflation have stagnated or grown much more slowly (Latin American and African economies). His empirical results indicate that inflation reduces growth by reducing investment and thereby reducing the rate of productivity growth. He also found that larger budget surpluses (or low budget deficits) were strongly associated with rapid growth, through greater capital accumulation and greater productivity growth. Foreign exchange market which was 'undistorted' was also found be conducive to growth. In other words, high inflation in developing countries may be expected to be associated with weak economic performance[6].

The inflation outcome in developing countries could be influenced by many variables. These, as will be discussed later, could be monetary, fiscal and structural variables argued and/or observed to be significant in the theoretical and empirical literature on inflation. In the present study we attempt to incorporate the implications of degree of openness on the domestic inflationary process in an economy. However as the economy opens up, the fiscal and monetary authorities tend to lose their ability to control inflation through fiscal and monetary policies. Fluctuations in the exchange rate, balance of payments (BoPs), and foreign investment inflows tend to have influence on the price and quantity dynamics in the economy in various ways. This issue is looked into empirically for a selected group of developing economies of Latin America, South Asia and East Asia using annual observations from 1980 to 1997.

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[3] These rigidities include downward inflexibility in nominal prices, susceptibility to supply shocks, bottlenecks in production and distribution, a narrow tax base, and underdeveloped financial markets. There is, no doubt, that these distortions and rigidities exist and they have serious consequences for the growth prospects in these economies. The recent RBI (2002) Report has also argued for a moderate rate of inflation for sustainable high rate of growth of the Indian economy

[4] As had been the case with Argentina, Brazil and Mexico in the 1970s and 1980s.

[5] Inflation can also have adverse impact on the financial sector. As a result of controls on nominal interest rate in many developing countries, high inflation tends to be accompanied by highly volatile (and often negative) real interest rates.. There is evidence, which indicates that negative real interest, rates and high inflation have a significant adverse impact on the financial savings and that low savings rates are generally associated with poor growth performance in developing economies (Aghevli and others, 1990). Unless inflation is brought under control the attempts of reforming the financial sector could get complicated. Finally the fixed exchange rate regimes could exacerbate the costs of inflation, as it does not allow depreciation of the local currency that worsens the competitiveness and encourages the flight of capital from the country.

[6] The analysis in his paper has been based on new growth theory using the cross-sectional regression methodology**,** as also the panel regression analysis for about 101 countries. The panel results typically reinforced the simple cross-section results.

The paper opens up in Section 2 with a review of the relevant theory on the relationship between inflationary process and openness. Section 3 examines the existing empirical literature on the link between inflation and openness. The model is formulated in Section 4 along with brief discussions about the variables. Section 5 discusses the empirical results and their interpretation. Section 6 gives the summary and conclusions of the paper.

II. Review of Theoretical Literature

The inflationary process has been a controversial topic in the literature, both theoretically as well as empirically. The precise nature of the relationship of price level with other macroeconomic variables has, despite years of research, remained an area of contention. The debate on the inflationary process in the *closed* economy context can be theoretically contained in these propositions:

The *Monetarist School* usually assumes a stable relationship between money-stock to nominal income. In their opinion '*fiscal deficit*' is the root cause of the inflationary process in so far as it affects money supply. They argue that by reducing the rate of growth of base money (H or M_0), which in most cases requires cutting down the 'fiscal deficit' of the government, the rate of inflation could be brought down[7]. Friedman argues, '*Inflation is always and everywhere a monetary phenomenon'* (1963, p 17). The role of money-financed fiscal deficits in the inflation process is theoretically well established and empirically documented (see for instance Polak, 1957; Khan and Knight, 1985)[8].

The Structuralist School, in contrast, argues that crucial sources of price rise are structural rigidities usually in the farm sector of a developing country. Excess demand drives up the price level triggering the inflationary process. Sectoral imbalances (caused by the rapid growth of the non-agricultural or industrial sector) could lead to an excess demand for wage goods and consequently it can result in rise in agricultural prices, as imports cannot come in[9]. This is often complemented by the *conflicting claims models* which gives an account of the inflationary process, by which clashing

[7] This happens because monetization of fiscal deficits is frequently the major source of excessive monetary expansion in developing countries with high inflation. However, if the fiscal deficit is financed through issuing of non-monetary debt it need not be inflationary. But even in these cases, there may be some inflationary effect to the extent that the deficit adds to the aggregate demand or because of expectations about future monetization.

[8] Moreover, the impact of the fiscal deficit on inflation will depend on the proportion that is financed through money creation and on the underlying growth rate of the economy. It is argued that the fiscal policy plays a crucial role in the inflationary process and fiscal correction, in their opinion, is likely to be a prerequisite for successful inflation stabilization ((IMF, 1990, p 57-8). However, It is usually difficult to find a significant relationship between inflation rates and fiscal deficits in cross-country comparisons.

[9] The increase in raw-material prices and the indexation of industrial money wages to price level results in the transmission of rise in agricultural prices to industrial prices, as enterprises simply pass on the rising costs to the consumers. In their view, there could be *no* autonomous development within the industrial and/or monetary sectors that would lead to continuous increase in prices (Sen and Vaidya, 1997, p 29).

claims of different social classes cannot be reconciled and inflation is argued to be a symptom of these conflicting claims (Sanyal, 1996; Bhaduri, 1986; Kalecki, 1972; Baer and Beckmann, 1974).

Cost-plus pricing is an important feature of the price formation process especially in the non-farm sector. This sector has been growing fairly rapidly in most of the developing countries (World Bank, 2000/1). This argument is based on the cost-push factors in explaining the inflationary process. Interest rate and food prices are supposed to be the main cost transmission channels in this context.

However, in the context of the open economy, these relationships are likely to undergo significant changes and could weaken the influence of above described variables.

The openness of an economy can be defined in various ways, for example, in terms of trade to GDP ratio, lower average tariff barriers, pruned import quotas, export subsidies, no barriers to foreign investment, government procurement policies etc.

The mechanisms through which openness can affect the inflation outcome could be many, the important ones being the following:

a) According to the 'new growth theory', openness is likely to affect inflation through its positive influence on the output, which is likely to ease the pressure on the prices[10] (see for instance, Jin, 2000). This link could be operating mainly through

   i) Increased efficiency which is likely to reduce costs through changes in the composition of inputs procured domestically and internationally;
   ii) Better allocation of resources;
   iii) Improved capacity utilization; and
   iv) Also increased openness could bring in foreign investment, which if channeled properly could stimulate output growth and correspondingly take further pressure off the price level.

b) As the economy opens up the shocks to the price level due to the domestic farm sector output fluctuations are likely to ease. In the more open economies this is likely to diminish the price fluctuations (Sanyal, 1996; Okun, 1981; Kalecki, 1972)[11].

c) The degree of integration of the domestic economy with the global economy could influence the level of domestic price level, as the domestic producers are likely to

[10] This link is going to work through the channel of reduced quantitative restrictions, which is the quantity link impact.

[11] In the Indian economy, for instance, inflationary phases have generally been characterized by rising prices of farm products, especially of foodgrains (Balakrishnan, 1991; Dantwala, 1986).

respond to international prices and not just to the domestic price level. This could result in upward pressure on the prices of those commodities, which usually are sold at lower than international prices in the domestic economy. The *reverse* is likely to happen for commodities, which are generally sold at higher than international prices. So, the net impact on domestic aggregate price level will depend on the interaction of overall effect on prices of various commodities in the domestic economy.

d) With the move towards opening up of the foreign exchange market, there has been a move away from a managed exchange rate regime towards floating exchange rate regime in many parts of the developing world. Exactly how this is going to affect the inflation outcome will depend on the degree to which the respective economies' import intensity changes in the more open trade regime, and the resultant influence on the cost structure of the various sectors of the economy.

e) With the World Trade Organization (WTO) committed to harmonization of tariff structure across countries, the import cost of a significant proportion of traded commodities is likely to go down. The tariff barriers have been coming down in almost all countries in a synchronized manner in the last few years. This is likely to soften the impact on the price level for the member countries to the corresponding extent. However, this is going to have effect on domestic inflation rate only in the transition stage.

These factors could have important implications for the process of inflation in any economy and therefore the influence of openness on the domestic inflationary dynamics in developing economies should be examined more carefully.

III. Existing Empirical Literature

The literature in economics on inflation and openness is relatively scant. The earliest papers by Triffin and Grudel (1962), and Whiteman (1969) had looked into economic performance of EEC and observed that more open economies tended to experience lower price inflation. Their explanation was that openness served as a safety valve and the domestic inflationary pressure spilled over into the BoPs in the open economy. Correspondingly this resulted in softening influence on domestic inflation.

Iyoha (1973) used a sample of 33 less developed countries and analysed the relationship for both yearly and 5-year averaged data from 1960/1 through 1964/5. The method used was OLS. The paper related inflation (proxied by rate of growth of WPI/CPI) and openness in simple bivariate framework. It was found that openness is negatively related to inflation. However, the results in the multivariate exercise were not unambiguous although openness variable always had negative sign but it was

found to be significant only occasionally. Changes in income and money growth were the other explanatory variables found to be significant when used separately. Otherwise, change in income variable tended to dominate the money growth variable. This could possibly be due to the presence of high degree of multicollinearity between the two variables.

Kirkpatrick and Nixon (1977) in their comment on the paper by Iyoha (1973) argued that cut down of imports could worsen the inflationary situation. They argued that composition of imports needs to be examined to check the inflation and openness link and more reliable indicators of openness are needed for a thorough understanding of the issues involved.

IMF (1990) in a review of the literature of inflation brought in the openness variable and argued its potential influence on the inflationary process in the developing countries. Since the early 1980s, external payments problems, and in particular the burden of debt, had become the main policy issue in many of the less developed countries. The debt crisis had been associated with a considerable weakening of growth and investment and deterioration in inflation performance across countries. Inflation in large part of the developing world had remained considerably higher than in the industrialized countries. In many of these countries inflation had still been a serious problem with some experiencing hyperinflationary situations. This paper besides the conventional variables, such as money growth[12] and fiscal deficit, which influence inflation process, brought in the import price and degree of openness as other possible factors that might influence the inflationary dynamics. There was, however, no empirical or econometric estimation in the paper.

Romer (1993) used a Barro-Gorden type model[13] to argue that openness puts a check on the government's incentive to engage in unanticipated inflation, because of induced exchange rate depreciation. He demonstrated that average inflation rate to be lower for smaller and relatively more open economies[14]. In addition, he finds this relationship to be significant, quantitatively large, and robust. This is supposed to be because the more open an economy the higher the possibility of her prices to come in alignment with the international prices.

Romer (1993)'s analysis started by regressing logarithm of inflation rate on openness for a cross-section of 114 countries. His results were found to hold for a wide range of countries, except for a small group of developed OECD countries. To check for the robustness of his results he introduced three sets of control variables. First was

[12] In the time series-analyses, the link between money growth and inflation is empirically well established for the high-inflation economies, but adjustment lags and shifts in money demand functions tend to weaken the short-run correlation in countries with more moderate rates of inflation. Nonetheless, in the longer run, a sustained increase in the rate of monetary expansion in excess of the desired increase in real balances eventually will result in a higher rate of inflation.

[13] Based on a standard closed economy model of dynamic inconsistency of optimal monetary policy.

[14] He measured inflation through average annual change in the log GDP (or GNP) deflator since 1973. Openness was measured as the average share of imports in GDP or GNP.

real income per capita[15]; this serves as a general measure of development and therefore capturing various factors influencing inflation. The second was a set of dummy variables for OECD membership and for various regions. Third the dummy for the use of the CPI instead of the GDP deflator to measure inflation and for the alternative measures of openness.

He goes on to test the hypothesis that the link between inflation and openness would be weaker in countries that are political more stable and that have more independent central banks. The proxies for these variables were taken from Barro, 1991 and Cukierman et al, 1992 respectively. These new variables, as expected, were also found to be strongly associated with average inflation rate. This is an interesting point of the study. The empirical analysis finds the relationship between inflation and openness to be stronger in countries which are politically less stable and with less independent central banks. Thus, the basic results were found to be robust to the inclusion of these variables.

He divided the countries of his sample in 4 broad groups: first group excluded the hyperinflation countries[16], second group, excluded the countries whose monetary policy is tied up with that of other countries[17]; thirdly, according to the quality of data, and excluding major oil producers; and fourthly, geographical region wise. The results were on expected lines except for a small group of most highly developed countries (mainly OECD countries)[18]. However, the explanation put forward for the OECD for which the results were not found to be working in terms of their having *solved the problem of dynamic inconsistency of monetary policy* does not seem to be an adequate explanation.

Lane (1997) using the same data set as Romer (1993) also found support for the above proposition of negative relationship between inflation and openness. An interesting finding was that the openness effect was stronger when country size was included as the control variable. This, in author's opinion, suggests that openness is not just working through a terms of trade effect. This paper, like Romer (1993), also included the proxies for '*central bank independence*' and *'political instability'*. The grouping used by her was based on rich countries, OECD countries, and the overall sample. Both these paper are mainly cross-section empirical analysis. This was partly necessitated by the need to analyze the influence of variables like central bank independence and political instability, the time series data on which is not easily available. However, the paper simply uses the 15-year (over 1973-1988) average of annual data and undertakes only a cross section analysis using OLS. This is done because the author is not claiming that the openness explains the cyclical behaviour of

[15] In log terms.

[16] That is, countries with more than 30 % average annual inflation rate.

[17] Particularly the ones using dollar rather than domestic currency.

[18]The explanation is also provided in terms of very little variation in the variables like political instability and central bank independence.

inflation. This process sacrifices the large degrees of freedom and restricts the flexibility of analysis from an empirical perspective[19]. This paper's empirical estimation is better suited in explaining cross-country differences than the changes in inflation performance over time within a country as the level of trade openness changes (p 339).

Terra (1998) also observed similar evidence in her paper written in response to Romer (1993) but she found the negative relationship between inflation and openness to be significantly influenced by the extent of indebtedness of the country. The paper divided the countries in 4 broad groups according to their level of indebtedness. In her opinion, this was because the 'overborrowed' countries have less pre-commitment in monetary policy due to which the negative relationship is stronger between inflation and openness among these countries than the others. The argument forwarded by the paper is that consider two countries with the same debt burden, therefore needing the same trade surplus to make the external transfer. Assuming identical price elasticities, the less open economy will need a larger exchange rate devaluation to generate the trade surplus. The devaluation, in turn, further tightens the internal constraint by raising the value of external liabilities in domestic currency; more resources will have to be transferred from private to the public sector. When inflation tax is the major mechanism for this transfer, a higher inflation rate will result. Hence, the less open a country is, the higher its inflation will be during a debt crisis. The regression results, however, were based on *bivariate* analysis and to that extent had limited relevance. Also debt was not introduced explicitly as a variable in the empirical analysis.

Jin (2000) in his analysis of East Asian economies found openness to be an important variable for growth but fiscal policy and foreign price shocks were coming out to be even more important in his analysis, which was based on the time series data for these economies using *vector auto regression* (VAR) framework.

Empirical studies of inflation in India have generally followed either a monetarist or structuralist approach. Moosa (1997), for instance, finds one to one correspondence between prices and money stock in case of Indian economy. Rao (1997) also finds similar evidence supporting monetarist approach. In one of the papers following structuralist framework, Balakrishnan (1991) models prices of manufactures through an error-correction specification based on a mark-up pricing rule using annual data 1952-80. Labour and raw material costs are both found to be significant determinants of inflation in the industrial; sector. Agricultural prices are modeled as a function of per capita output, per capita income of the non-agricultural sector, and government procurement of foodgrains through the public distribution system. Bhattacharya and Lodh (1990) too find the superiority of the structuralist over the monetarist model in explaining Indian inflation. Mallick (1998) finds that cost-push factors are more important in causing price level than the excess demand, as the magnitude of its impact is very negligible. Price level, measured by the wholesale price index is positively and significantly affected by the domestic unit labour costs and the cost of imported inputs (measured in US dollars). This model combines both demand and supply factors and suggests a weak role of money in its influence on prices in India. However, the

[19]That means it uses only the between estimator model for the empirical analysis.

empirical literature in India does not report openness to be a significant factor in explaining the inflation outcome.

IV. The Model

Inflation is a complex process and it is difficult to find a single empirical model that fits the circumstances of all the developing countries. It is, however, possible to identify key elements, which might influence the inflation process in different economies.

In an open economy, the domestic price level and international price level would be equated. The relation between the two prices could be expressed as:

$$P_i = (P_d) / (E)$$

Where P_i = International Price level
P_d = Domestic Price level
E = Exchange rate; i.e. Price of International currency in terms of Domestic Currency

Taking the rate of growth, we get

$$\Delta P_i/P_i = (\Delta P_d/P_d) - (\Delta E/E)$$

This shows that the domestic inflation minus the change in the exchange rate would be equated to international inflation. In other words, whenever there is change in any one of the three terms, for the equality to be restored adjustments would be required in at least one of the variables on the right hand side of the equation.

In the case of regulations in the exchange rate markets[20] - as is generally the case with most of the developing countries - the adjustment would take place mainly through the trade channel. In this situation the domestic price level will largely bear the burden of restoring the balance in the external sector. If the domestic prices are higher than the international prices then there will be imports in the country which will put downward pressure on the domestic price level and *vice versa*. Since, the international prices are arrived at by pooling over large number of economies, assuming factors driving inflation in the constituent economies would differ, such process of pooling would produce more stable prices. Aligning with international economy, therefore, is expected to have stabilizing influence on the domestic prices.

[20] Either the fixed exchange rate or pegged to certain international currency.

The trend in recent years has been towards greater opening up of the international trade in most of the developing countries (See Graph 2 A and B). This exercise looks at the domestic price inflation and how it is influenced by the extent of openness.

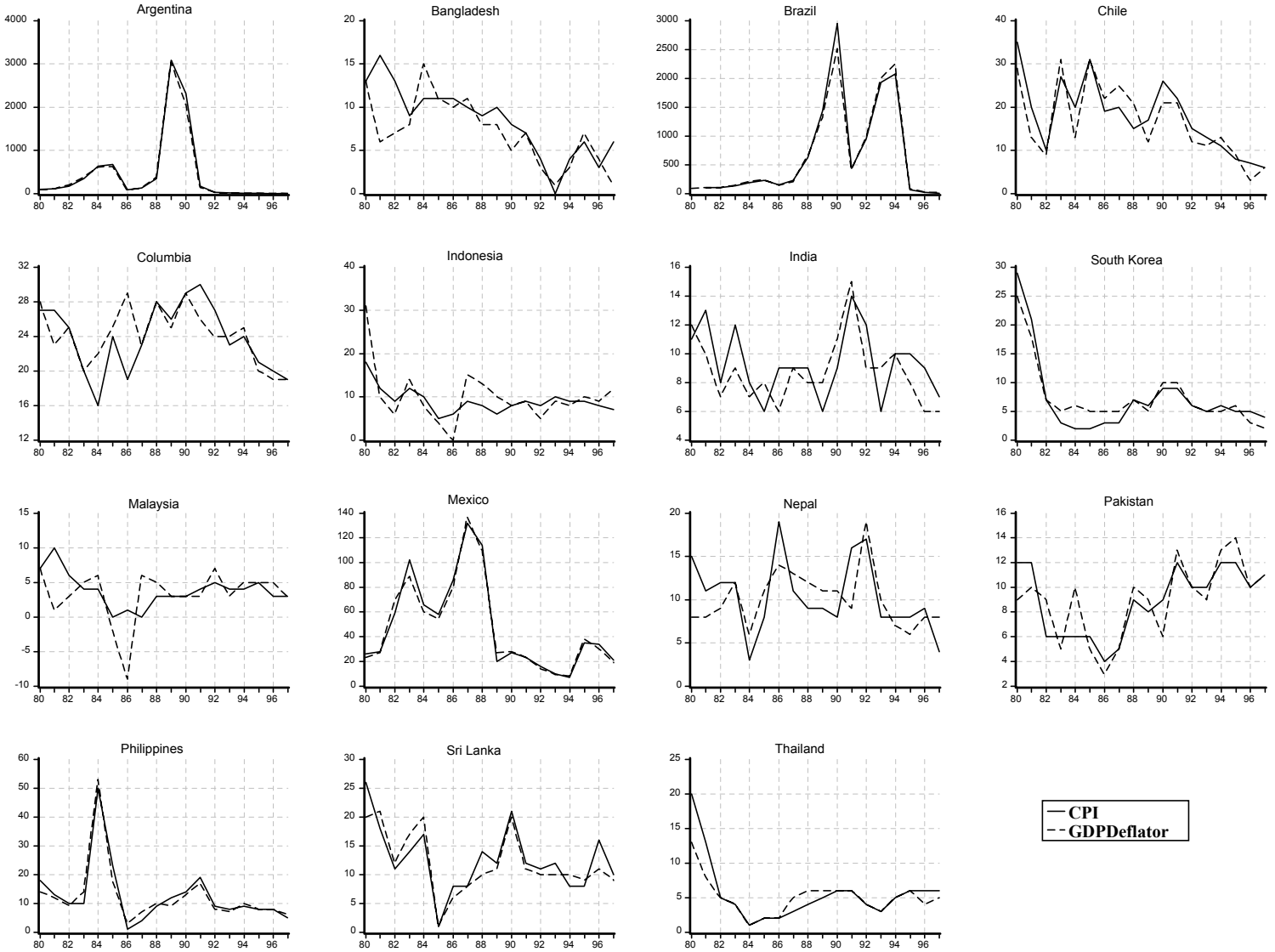
In the following empirical analysis openness is taken as the independent variable as it is the realised impact of a combination of the policies of the government in a country and the external shocks. The openness variable is proxied by

1. Trade to income ratio computed from value of export of goods and services *plus* value of imports of goods and services as a proportion of gross domestic product (GDP), at nominal prices;

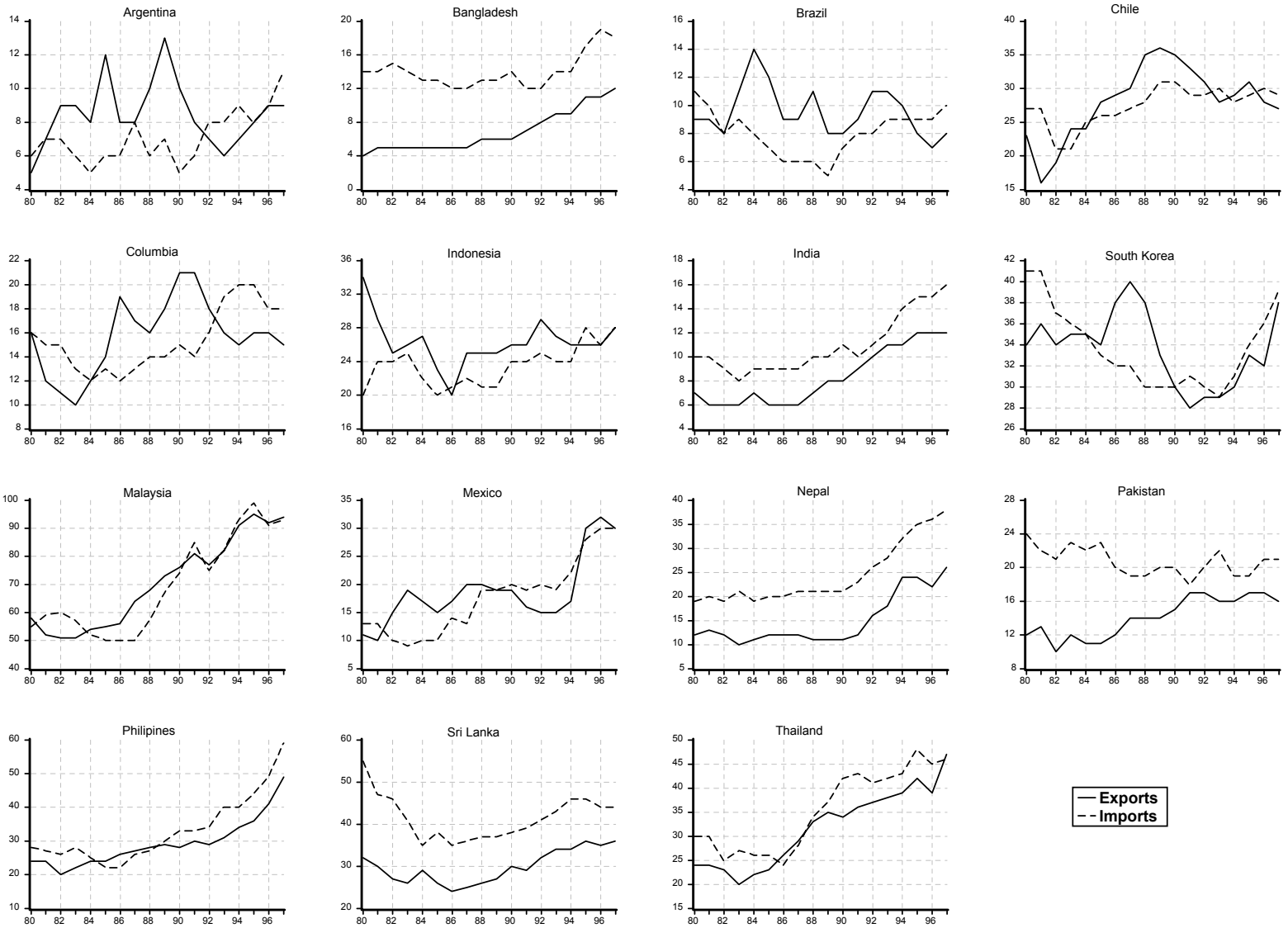
2. Import to income ratio and exports to income ratio computed by taking export and imports of goods and services respectively as a proportion of gross domestic product, both at nominal prices;

As discussed above, there are various other possible measures that could be used as a proxy for openness but it is difficult to obtain long historical time series for most of these. So, we restricted ourselves to trade to income ratio, or the pair of export to income, and import to income ratio. The former indicates the overall openness of the economy. The latter pair helps to decompose the aggregate impact of trade on the inflationary process as the two are likely to influence the inflation dynamics in a differentiated manner. Import to income ratio reveals the import penetration that represents the degree of openness: the more open an economy, the lesser the restrictions in world trade, higher will be the import penetration in the domestic economy. Graph 1 and Graph 2 show the level of inflation and openness in these economies for the 1980 to 1997 period. Export to GDP ratio reflects the influence of foreign demand, which could also potentially affect the domestic inflationary process.

In addition to the openness variable/s, the other variables, which could influence the inflation outcome, were also considered (see Section 2 and 3 above). These included interest rate, money stock (monetary variables), agricultural output, national income (output variables), external debt, exchange rate, fuel imports, foreign investment as a proportion of GDP and domestic investment (external sector variables), public expenditure (fiscal variables) etc.



Graph 1: Domestic Inflation Rate - GDP Deflator and Consumer Price Index



Graph 2: Openness Measure: Export and Imports as a percent of GDP

In order to test the hypothesis of influence of degree of openness on the inflation, which emerges from the theoretical and empirical literature, the following model was estimated:

$$\mathbf{Y} = \beta_0 + \beta_1 [\mathbf{X_1}] + \beta_2 [\mathbf{X_2}] + \beta_3 [\mathbf{X_3}] + \varepsilon$$

Where[21]

Y, the *dependent variable*, is the **inflation rate (based on GDP deflator or consumer price index)**[22] [23].

$\mathbf{X_1}$ = ***rate of growth of real agricultural value added***. Although this variable is not generally used in the empirical literature on inflation and openness but as we saw in the section on theoretical literature it could have significant influence on the inflationary process in the developing countries but openness might reduce its influence.

$\mathbf{X_2}$ = ***the average annual growth rate of money and quasi money (or M2)***. As discussed earlier it is generally found to be most important variable in the context of understanding inflationary dynamics and therefore has been used in the present analysis.

$\mathbf{X_3}$ refers to Openness of an economy and is captured by two alternative measures, such as:

a. Trade in goods and services as percent of GDP; and

b. Exports, and Imports of goods and services as percent of GDP, separately. In effect, these are two independent variables.

We expect that

$$\beta_1 < 0, \beta_2 > 0, \beta_3 < 0$$

[21] For a detailed discussion of data series and sources see Appendix A.

[22] We also tried rate of growth of exchange rate as an independent variable in the pure inflation regression formulation. The results were on expected lines and its coefficient had the appropriate positive sign. This shows the fluctuations in the exchange rate directly influence the inflation situation. However, we did not go further in this aspect as the main intention of this paper was to analyze the influence of degree of openness on inflation (in international currency) .

[23] We also tried government expenditure as a percent of GDP, fuel imports, foreign debt-to-GDP ratio, FDI as a percent of GDP, FDI as a percent of investment, interest rate but we did not find any of these to be statistically significant and therefore, dropped them from the further analysis.

The empirical analysis in this paper is based on a panel data exercise for fifteen developing economies. These are Argentina, Brazil, Chile, Colombia, Mexico, from the Latin America; Bangladesh, India, Pakistan, Nepal, Sri Lanka, from South Asia; and Indonesia, Malaysia, Thailand, Philippines, and South Korea from East Asia. We consider following alternative groupings to investigate the potential difference in the results from changing the composition of the group. The groupings considered are

a) All 15 economies together;
b) Non-hyperinflation and hyperinflation economies grouping i.e. segregating the panel on the basis of average annual inflation rate in excess of 30 per cent for hyperinflation economies;
c) Area wise small and large economies, where small is defined as one with size of less than 500,000 square miles
d) Geographical location wise classification of economies: these had three sub-groups – South Asia, East Asia and Latin America
e) High and low income economies: high income economies were defined as the one having per capita of over and above US $ 2000 and low income as the remaining[24], and
f) Emerging economies grouping (based on the classification by The Economist).

V. The Estimation Procedure

The main advantage of a panel data model, when compared to time series or cross-section analysis, is that it increases the degrees of freedom significantly. Thereby, it allows for lot of flexibility in the empirical estimation. Combining cross section and time series data makes it possible to incorporate a much larger number of explanatory variables In carrying out the empirical exercise we explored fixed effects, and random effects estimation methods (Greene, 1997, Johnston and Di Nardo, 1997).

V.1 Fixed Effects Model

Fixed effect *(FE)* model allows for differences in the intercept among cross section units. FE model is a reasonable approach when we are confident that the difference between cross-section units can be viewed as parametric shifts of the regression function. That is it is based on the assumption that difference across cross sections can be captured through intercept.

[24] We also tried three-way classification of high, middle, and low income economies but that did not add much to the empirical understanding.

$$\mathbf{Y_{it}} = \boldsymbol{\alpha_i} + \mathbf{X_{it}}' \beta + \varepsilon_{it}$$

Where

i = 1, 2,…, 15
t = 1, 2,…, 18

i refers to cross section (or the group) and **t** refers to year.
Note: The component or intercept (α_i) in this model differs across cross-section units but is time-invariant.

Assumptions of the *fixed effect* model (Wooldridge, 1999, p 459)

1. $E(\varepsilon_{it}| X_{it}) = 0$
2. No multicollinearity among the explanatory variables. That is, there are no perfect relationships among the explanatory variables.
3. $V[\varepsilon_{it}| X_{it}] = V[\varepsilon_{it}] = \sigma_\varepsilon^2$ for all t = 1,2,…,T and all i= 1,2,…,n.
4. $Cov[\varepsilon_{it}\varepsilon_{js}| X_{it}] = 0$ for all $t \neq s$ (errors are uncorrelated over time).
5. Conditional on X_{it}, the ε_{it} are independent and identically distributed as Normal $(0, \sigma_\varepsilon^2)$.
6. $E(X_{it}\, \alpha_i) \neq 0$

Under these assumptions the *fixed effect* estimator of β is the best linear unbiased estimator. The Assumption 4 implies that the errors are serially uncorrelated.

This model could be estimated by the least squares dummy variables method. This is a classical regression model.

V.2 Random Effects Model

In contrast to FE model, the random effects (RE) model views individual specific constant terms as randomly distributed across cross-sectional units. This would be appropriate if we believed that sample cross-sectional units were drawn from a large population.

The RE model could be represented as follows:

$$\mathbf{Y_{it}} = \boldsymbol{\alpha} + \mathbf{X_{it}}' \beta + \mu_i + \varepsilon_{it}$$

Where

i = 1, 2,…., 15
t = 1, 2, …, 18

Note: The component μ_i is the random disturbance characterizing the i^{th} observation and is constant through time. The RE formulation assumes that intercept term has random element whereas the FE formulation does not. This is the first difference between the two estimators.

1. $E(\mu_i) = 0$
2. $V(\mu_i) = \sigma_\mu^2$
3. $E(\mu_i \mu_j) = 0$ for all $i \neq j$

This model could be rewritten as

$$\mathbf{Y_{it}} = \boldsymbol{\alpha} + \mathbf{X_{it}}' \beta + \eta_{it}$$

Where $\eta_{it} = \mu_i + \varepsilon_{it}$

Then for this error components' model

4. $E(\eta_{it}^2) = \sigma_\varepsilon^2 + \sigma_\mu^2$
5. $E(\eta_{it} \eta_{is}) = \sigma_\mu^2$ for $t \neq s$

In addition to the above assumption and the assumptions in the FE model we also require another assumption (in place of the 6th assumption)

6. $E(X_{it} \mu_i) = 0$

It can be noted that μ_i – i.e. the cross-section specific error term in RE model - is uncorrelated with X_{it} whereas α_i – cross-section specific term in the FE model - is correlated with the X_{it}. This is the second difference between the two estimators.

The estimation in case of the RE model is done using the feasible generalized least squares (FGLS) method as necessitated by its error variance structure.

The two estimators – FE and RE - have different properties depending on the correlation between group specific effects and the regressors

I. If the effects are uncorrelated with the explanatory variables, the RE estimator is consistent and efficient. The FE estimator is consistent but not efficient;

II. If the effects are correlated with the explanatory variables, the FE estimator is consistent and efficient but the RE estimator is now inconsistent.

This difference is utilised to construct the Hausman test, which helps decide the choice between the FE and the RE estimator. The null hypothesis under the Hausman test is

H_0 = Effects and explanatory variables are uncorrelated.

The test statistic is defined as

$$\mathbf{H} = (\beta_{RE} - \beta_{FE})' (\Sigma_{FE} - \Sigma_{RE})^{-1} (\beta_{RE} - \beta_{FE})$$

Where RE and FE refer to random effects and fixed effects estimates respectively and Σ stands for the estimated variance-covariance matrix. Under null hypothesis the test statistic follows asymptotically a chi-square distribution with k degrees of freedom, where k is the number of coefficients compared. If test statistic is greater than 'critical value' of the chi-square distribution at appropriate degrees of freedom we reject the null hypothesis (Johnston and Di Nardo, 1997).

The final estimation results used in the paper, for which the results are reported in Tables 3A, 3B, and 3C, were based on random effects model using the *Feasible Generalised Least Squares* (FGLS) estimation method. This was done on the basis of the Hausman test (reported in Table 3B and 3C).

VI. Empirical Findings and Interpretations

Table 1 summarizes the means and coefficients of variation (CV) of different inflation and openness indicators for the countries covered in the empirical analysis. As can be noted from the table, almost all the countries have experienced an increase in their level of openness in the nineties relative to the eighties reflecting consensus among broad range of developing countries about its advantages. Average inflation rate has varied widely across these countries. Argentina, Brazil & Mexico have generally experienced high rates of inflation relative to other countries in the panel. These economies are also referred to as hyperinflation economies in the literature. For the rest of the economies, inflation rate is below 10 percent, barring Chile and Columbia.

Table 2 presents the correlations between the inflation rate (based on GDP deflator and CPI) and measures of openness (i.e. trade; exports; and imports – all as a percent of GDP) for all the countries in the panel. Correlation of inflation with trade across countries gives mixed results. For seven out of the fifteen countries it has negative sign and for the rest it has positive sign. As the influence of exports and imports on inflation could be different, so this is not inconsistent. Next, we decompose trade openness into exports and imports (both as percent of GDP). The correlation coefficient of exports with the inflation rate has expected positive sign for ten out of the fifteen countries. The correlation coefficient of imports with inflation also has expected negative sign for eleven out of the fifteen countries in our panel. The correlation exercises being essentially bivariate and simplistic calls for exploration in a more rigorous framework. This is what the remaining part of this section attempts to do

TABLE 1: Inflation and Measures of Openness: Average for each country

	Argentina	Bangladesh	Brazil	Chile	Colombia	Indonesia	India	S. Korea	Malaysia	Mexico	Nepal	Pakistan	Philippines	Sri Lanka	Thailand
Trade of goods and Services as a percent of GDP															
1980-97	15.61	21.11	17.61	55.56	31	49.94	19.11	67.61	140.06	36.5	39.33	34.89	62.22	71.5	66.94
1980-89	15.2	18.6	17.6	52.5	28.2	48.1	15.8	70.7	113.9	29.4	31.7	33.6	51	68.1	54.5
1990-97	16.13	24.25	17.63	59.38	34.5	52.25	23.25	63.75	172.75	45.38	48.88	36.5	76.25	75.75	82.5
CV	0.15	0.20	0.12	0.13	0.13	0.08	0.24	0.09	0.23	0.33	0.30	0.06	0.27	0.11	0.24
Imports of goods and Services as a percent of GDP															
1980-97	7.11	14.06	8.06	27.44	15.39	23.5	10.94	33.72	69.39	17.67	24.44	20.72	32.94	41.56	35.39
1980-89	6.4	13.3	7.6	25.9	13.7	22	9.3	34.7	55.7	13	20.1	21.3	26.1	40.7	28.7
1990-97	8	15	8.63	29.38	17.5	25.38	13	32.5	86.5	23.5	29.88	20	41.5	42.63	43.75
CV	0.22	0.15	0.20	0.11	0.17	0.10	0.22	0.11	0.25	0.38	0.26	0.08	0.30	0.13	0.24
Exports of goods and Services as a percent of GDP															
1980-97	8.5	6.89	9.56	28.11	15.72	26.28	8.33	33.67	70.56	18.72	14.94	14.11	29.22	29.89	31.72
1980-89	8.9	5.1	10	26.4	14.5	25.9	6.5	35.7	58.2	16.3	11.6	12.3	24.8	27.2	25.9
1990-97	8	9.13	9	30.25	17.25	26.75	10.63	31.13	86	21.75	19.13	16.38	34.75	33.25	39
CV	0.23	0.36	0.19	0.19	0.20	0.11	0.29	0.10	0.23	0.33	0.36	0.17	0.24	0.13	0.25
Inflation (GDP deflator) (per cent per annum)															
1980-97	437.06	7.11	636	16.78	24.11	10.06	8.78	7.5	3.28	46.89	10.11	8.94	12.56	12	5.06
1980-89	563.8	9.7	321	20.6	24.8	11.1	8.4	8.8	2.5	67.5	10.4	7.5	14.9	12.6	5.2
1990-97	278.63	3.88	1029	12	23.25	8.75	9.25	5.88	4.25	21.13	9.75	10.75	9.63	11.25	4.88
CV	1.83	0.49	1.29	0.43	0.17	0.22	0.26	0.73	0.64	0.78	0.42	0.31	0.88	0.40	0.56
Inflation (CPI) (per cent per annum)															
1980-97	475.65	8.12	683.35	16.88	23.59	8.53	9.24	6.06	3.65	49.29	10.12	8.71	12.47	11.82	4.76
1980-89	617.33	11.11	355	19.89	23.11	8.56	8.89	6	3.44	73.89	10.44	6.89	14.67	11.44	4.33
1990-97	316.25	4.75	1053	13.5	24.13	8.5	9.63	6.13	3.88	21.63	9.75	10.75	10	12.25	5.25
CV	1.83	0.49	1.29	0.43	0.17	0.22	0.26	0.73	0.64	0.78	0.42	0.31	0.88	0.40	0.56

Source: Computed from the World Bank (2000)

Table 2: Correlation between Inflation and Openness Indicators

	GDP deflator			CPI		
	Trade	Exports	Imports	Trade	Exports	Imports
Argentina	0.33	0.70	-0.36	0.30	0.72	-0.39
Bangladesh	-0.61	-0.73	-0.43	-0.57	-0.76	-0.32
Brazil	-0.11	0.04	-0.19	-0.13	-0.02	-0.17
Chile	-0.09	0.06	-0.35	-0.05	0.05	-0.25
Colombia	0.11	0.49	-0.35	0.28	0.44	-0.02
Indonesia	0.44	0.75	-0.15	0.52	0.56	0.35
India	-0.16	-0.08	-0.21	-0.07	-0.06	-0.11
Korea	0.29	-0.04	0.50	0.14	-0.13	0.33
Malaysia	0.28	0.28	0.28	0.08	-0.06	0.21
Mexico	-0.25	0.03	-0.47	-0.31	-0.01	-0.52
Nepal	-0.32	-0.37	-0.30	-0.33	-0.34	-0.32
Pakistan	0.40	0.57	-0.35	0.67	0.77	-0.32
Philippines	-0.32	-0.31	-0.30	0.09	-0.32	-0.31
Sri Lanka	0.26	0.11	0.32	-0.33	0.12	0.03
Thailand	0.08	0.01	0.13	0.25	0.18	0.30

Source: Computed from the World Bank (2000)

The model was estimated with inflation rate (GDP deflator or CPI) as the dependent variable and growth of money stock , growth in agricultural output, and different measures of openness as the explanatory variables[25] (Table 3A, 3B and 3C). In the final results, the trade openness (exports plus imports as a percent of GDP) was dropped from the analysis as this was consistently found to be statistically insignificant. This is possibly a result of the differential impact of exports, and imports in the inflationary process, acting against each other when pooled.

The final empirical analysis was based on different grouping of countries. We started with the aggregate analysis for all the 15 countries of the panel. Then we used the following groupings within this panel; first, consisted of non-hyperinflation economies, which were observed to be significantly and systematically altering the overall results. Second grouping relates to the geographical size of the countries. In the third grouping, we analysed the economies on the basis of their regional location. These groupings consisted of South Asia, East Asia and Latin America. Fourth form of classification was based on the high and low per capita income. Classification of the economies into emerging and non-emerging or of the time period into pre- and post 1990 did not yield statistically significant differences in behaviour. All these groupings were analysed using slope dummies. The results are analysed next.

[25] We also tried government expenditure as a percent of GDP, fiscal deficit as a percent of GDP, interest rate, fuel imports, foreign debt-to-GDP ratio, FDI as a percent of GDP, FDI as a percent of investment but we did not find any of these to be statistically significant and therefore, dropped them from the further analysis.

All Country grouping: The results for the overall panel of fifteen countries show that the usual macro variables, such as rate of growth of money stock, a reasonable proxy for monetary policy, and rate of growth of agricultural output have expected and statistically significant impact on the domestic inflationary process in these countries. Further, we observe that exports, and imports of goods and services (both as a percent of GDP) had a significant influence on the inflation rate. The exports were observed be positively associated with inflation rate whereas imports were observed to have a negative impact (see Table 3A). The coefficient of rate of growth of money (gM) was (+) 0.84 and statistically significant at 1 percent throughout our analysis. Even the coefficient was not found to be very different for various sub-groupings examined in this paper. This shows that money remains an important determinant of the inflationary process in these economies. The coefficient of rate of growth of agricultural output (gQagr) was also observed to be consistently significant at 1 percent level in the aggregate as well as for analysis of different groups. The sign of its coefficient is also observed to be negative consistently, as we would expect, although the size of the coefficient varies significantly across different groups of countries as will be clear in the discussion of detailed results, which follows. Trade openness as a percentage of GDP (defined as exports plus imports as a percent of GDP) did not give statistically insignificant result and therefore was dropped from the analysis. This is possibly due the effect of the two works against each other and cancels out. The coefficient for the aggregate analysis stood at (-)11.34 which means that 1 percent growth in agricultural output leads to about 11 percent fall in the inflation rate. The coefficient of exports to GDP ratio (X-Y Ratio) stood at (+) 24.1 and for import to GDP ratio (M-Y Ratio) at (-) 21.1. Both have the expected signs. The coefficients indicate significant influence of both on the inflationary process; however, both tend to neutralise each other's influence on inflation. The net effect of these two on inflation will depend on the difference of the coefficient weighted by the quantum of imports and exports respectively. Further we brought in the square of the two openness proxies to determine whether their incremental influence is rising or falling. It was found that in the aggregate panel, the incremental influence of both the variables becomes weaker with increase in their levels.. The coefficients of the $(\text{X-Y Ratio})^2$ and $(\text{M-Y Ratio})^2$ stood at (-)0.24 and (+) 0.204 respectively.

Hyperinflation and non-hyperinflation economies[26]: Taking a clue from a very high coefficient for agricultural output growth on inflation, the first sub-grouping considered was on the basis of high and low inflation. Bringing in the dummies for non-hyperinflationary economies did this. This model shows that the coefficients are very different for the two sets of countries. The coefficient for agricultural output growth was found to be much smaller at (+)1.13 for the non-hyper inflation countries. This seems more plausible for these economies. For the hyperinflation economies the coefficient stood at (-)36.14. This show that for each percentage point increase in agricultural output the inflation rate fell by about 36 percent in the hyperinflation economies and by only 1.13 per cent in the others. The coefficient of growth of money stood at (+)0.86, similar to aggregate panel result. The coefficient for X-Y ratio also fell sharply to (+)0.53 for the non-hyperinflation economies (it was 48.7 for hyperinflation countries) which means if the ratio increases by one percentage

[26] This classification was also adopted by Romer (1993).

point the impact on rate of inflation will be only to the tune of (+) 0.5 percentage points. On the other hand, the M-Y ratio, which stands at (–)0.95 [(-)34.5 for hyperinflation countries], indicating a decline in inflation of 0.95 percent for every percentage point increase in the ratio. In other words, an equal increase in both exports and imports (as percent of GDP) would leave the level of inflation lower by about half percent. For the hyperinflation economies the inflation rate would actually rise by about 14 percent.

Small and large economies grouping: Next we examined the difference between the small and large economies in the panel. This difference was based on the segregating the country on the basis of area[27]. The money growth – gM – [coefficient (+)0.86] and agricultural output growth – gQagr – [with coefficient (-)1.85] had the expected sign and both were significant at 1 percent, as earlier. The coefficient of X-Y Ratio was observed to be (+)7.3 which means 1 percent increase in the X-Y Ratio raises the inflation rate by about 7 percent. In contrast, the coefficient of M-Y Ratio stood at (–) 12.5 percent, much larger in its influence on the inflation for each extra percent rise in its share in the GDP. The square term for the X-Y Ratio and M-Y Ratio had the sign as earlier but were found to be statistically insignificant.

Grouping based on geographical location[28]: Next classification of countries was based on geographical location. These consisted of South Asia, East Asia, and Latin America. South Asia did come out as an important group for which the results were quantitatively different. The coefficient for rate of growth of money – gM – [coefficient (+)0.87] and agricultural output growth – gQagr - [having coefficient (-)1.38], here too, had the expected sign and both were significant at 1 percent. The coefficient for X-Y Ratio was (+) 8.4 much larger than the coefficient for M-Y Ratio, which was (-) 15.2. This indicates that the impact of a rise in M-Y Ratio is much larger relative to X-Y Ratio in its influence on inflationary dynamics in the South Asian region as compared to the economies of East Asia and Latin America. This is possibly due to the importance of imports in the domestic production process, which has an enhancing effect on the productivity of the economy. This, then, possibly gets translated into reduced pressure on prices in these economies (as argued by Jin, 2000). The square of X-Y Ratio and square of M-Y Ratio show reduced incremental impact of the X-Y Ratio and M-Y Ratio, these, however, were not found to be different across the regional location grouping used here.

East Asia was found to be no different from the rest of the economies. Latin America made the result skewed in its favor as this consisted of hyperinflation economies. Therefore, these results are not reported[29]. The South Asian economies happen to be poorest in our panel of fifteen countries. This inspired the next classification for the countries in the panel that was based on the level of per capita income: high and low.

[27] With the geographical area of 500,000 square miles or more classified as large and rest as small.

[28] This classification was also adopted by Romer (1993), as discussed earlier.

[29] These results are available on request with the author.

High and low-income economies grouping[30]: The high-income economies were defined to be those economies which had per capita income of US $ 2000 and above in the beginning year of the panel time period, i.e. 1980. The analysis shows that the inflation in the two sets of economies is affected differently by the extent of openness as reflected by the X-Y Ratio and M-Y Ratio. In this panel result also, as earlier, both the rate of growth of money – gM – [with coefficient of (+) 0.86], and agricultural output growth – gQagr – [with coefficient of (-)1.08] were found to be significant at 1 percent and had the expected sign.. The coefficient of X-Y Ratio stood at (+) 27.12, which shows a very high coefficient indicating strong impact of X-Y Ratio on the inflation rate in these economies. The coefficient for M-Y Ratio was (–)31.6, also very large, and was even larger than the coefficient of X-Y Ratio. These coefficients for the non-high-income economies stood at (+)10.96 And (–)16.44 for X-Y Ratio and M-Y Ratio respectively which are much lower. The large coefficients of the openness variables for the high-income economies is possibly due to the higher level of integration of different sectors in these economies which transmits the cascading effect of exports and imports quickly in the overall economy as compared to the low-income economies. The net inflationary impact of same percent rise in the X-Y Ratio and M-Y Ratio would ease pressure of the inflationary pressure in the high-income countries by little over 4 percent, and by about 5.5 percent in the low-income economies. The sign of coefficient of 'square-X-Y Ratio' and 'square-M-Y Ratio', in this classification too, show reduced incremental impact of the X-Y Ratio and M-Y Ratio. These two, however, were not found to be statistically different across the high and low-income economies.

The discussion of the results so far refers to the inflation rate based on GDP deflator. Using Consumer Price Index as the basis for measuring inflation too provides virtually same results, which are summarised in Tables 3A, 3B and 3C. All the coefficients were found to be significant at 5 percent level, except for the ones mentioned, and most of the coefficients were found to be significant at 1 percent level as well. The random effect estimators were chosen over the fixed effect estimators based on the results of the Hausman specification test[31].

VII. Summary and Conclusions

The empirical results in this paper, to some extent, substantiate the existing literature. Besides the usual macro variables like rate of growth of money (found to be important by Iyoha, 1973 and IMF, 1990) and agricultural output growth the openness variables (proxied by export to GDP ratio and Import to GDP ratio)[32] were found to be significantly influencing the domestic inflation in the panel of 15 countries used in the empirical analysis. These are somewhat in congruence with the monetarists who argue money to be the most important variable affecting the inflationary process. Although where it differs from them is that agricultural output growth is also found to be an important explanatory variable affecting inflationary process. Together they point to the structuralist type of inflationary

[30] This classification was adopted by Lane (1997) as well.

[31] See the discussion in the earlier section on these and related empirical issues.

[32] Trade openness as a percentage of GDP was also tried but was found to be statistically insignificant and therefore was dropped from the analysis.

dynamics in these economies. However, the importance of 'openness variables' indicates that that is not a sufficient explanation.

The openness variables (M-Y Ratio and X-Y Ratio) were found to be significantly affecting the inflationary process but in a way just opposite to each other. Whereas M-Y Ratio was observed to reduce the inflationary pressure, a higher X-Y Ratio tended to accentuate the inflationary pressure in these economies. These results hold for wide range of countries within this panel of 15 countries.

The result with respect to negative impact of M-Y Ratio on inflation is similar to other papers such as Romer (1993) and Lane (1997) although there is no clear evidence on X-Y Ratio in the their paper or other empirical literature. In fact, most studies do not even mention it. Here the result of positive impact of X-Y Ratio on inflation is adding to the understanding of the impact of openness on inflationary process and it is instructive.

These results indicate that the traditional closed economy explanation for inflationary process remains important and adding the openness variables in the analysis complements the analytical and empirical perspective. The empirical analysis also examined the possible differences across these countries by dividing them in different categories as discussed in detail in the previous section.

The results, for instance, for non-hyper inflation and hyperinflation economies (classification used by Romer, 1993 also) were found to be statistically very different, especially with respect to impact of agricultural output growth as also for the openness variables. The coefficient for agricultural output growth was found to be much smaller for the non-hyperinflation countries compared to for the hyperinflation economies. This is something that one would expect. The coefficient for X-Y ratio for the non-hyperinflation was also found to be much lower relative to the hyperinflation countries. The coefficient for M-Y ratio, on the other hand, was also found to be much smaller (in absolute terms) for the former relative to the latter. In other words, an increase of 1 percent in both exports and imports (as a percent of GDP) would leave the level of inflation lower by about half percent in the non-hyperinflation economies whereas for the hyperinflation economies it would result in rise in the inflation rate to the tune of 14 percent.

The results for openness for small and large economies were also found to be quite different, and statistically significant. The coefficient of X-Y Ratio and M-Y Ratio for small economies were much smaller (6.7 and –11.6 respectively). These coefficients were much larger for the area-wise large economies (31.3 for X-Y Ratio and –37.1 for M-Y Ratio). This shows that the smaller economies are affected, to a lesser extent, by openness relative to large economies. This result possibly indicates that relatively more dynamic nature of the smaller economies and possible synergy between their domestic prices with international prices. However, the net effect of the rise in export and import (as a percent of GDP) is found to be having reduced pressure on the inflation rate in both set of economies.

In the case of the South Asian economies, openness coefficient stood at (+)8.93 for X-Y Ratio and (–)3.52 for M-Y Ratio. This is quite different from coefficient of X-Y Ratio and M-Y Ratio for the non-South Asian Countries that were observed to be much higher at (+)23.85 and (–)28.02 respectively. South Asia consists of poorest countries in the region, which potentially explains to some extent, this difference in the coefficients.

Taking a clue from the poor South Asian classification, next classification was done on the basis of high-income and low-income economies, classification also used by Lane (1997). This further substantiated the findings. It indicated a much larger coefficient for X-Y Ratio and M-Y Ratio for the high income economies at (+)27.1 and (–)31.6 relative to (+)10.97 and (–)16.44 for the rest. The net impact on reducing inflation of same percentage increase in the export and imports was found to be much higher for the high-income economies relative to low-income economies.

The results and relationships were found to be robust across different models used in the analysis with 'overall R-square' generally in the range of 0.61 an 0.69. The results of this paper indicate that to study impact of openness on inflation, in addition to imports, we should also incorporate exports in the analysis, as they were also found to be influencing the inflationary process as well.

The negative influence of imports on inflationary process is well established in the empirical literature and our result is on the similar to the findings of other studies in this context. So, the present study substantiates the argument put forward by Iyoh (1973) that cutting down of imports could worsen the inflationary situation. Though his results were based on the developed economies of the 1960s but, interestingly, they seem to be substantiated for the developing economies in the eighties and nineties as well. This could be happening through productivity gains and through other channels (see point a, p 4 above, and Jin, 2000), which release some pressure off the inflation rate.

This empirical exercise also points to the fact that the influence of exports and imports on inflationary process need not be linear. The coefficient of the square of the openness variables suggests that for each incremental change in each one has reduced impact on the inflation rate in these economies. As more and more developing economies are adopting the flexible exchange rate regime the impact of exchange rate on the inflationary process could become potentially very important. This aspect, however, was not explored in this paper in detail but it needs to be examined carefully in the future empirical analysis.

Table 3A: Inflation and Measures of Openness: Alternative specifications

Sample 1980-1997

	GDP deflator				CPI			
	Model 1		Model 2		Model 1		Model 2	
	FE	**RE**	**FE**	**RE**	**FE**	**RE**	**FE**	**RE**
(gM)	0.821	0.863	0.813	0.841	0.856	0.895	0.848	0.872
	(15.17)	(19.32)	(15.05)	(17.95)	(14.86)	(18.83)	(14.73)	(17.48)
(gQagr)	-1070.143	-1073.317	-1072.516	-991.314	-1138.114	-1138.798	-1133.946	-1051.692
	(-2.90)	(-3.06)	(-2.91)	(-2.81)	(-2.90)	(-3.05)	(-2.89)	(-2.80)
(X-Y Ratio)	9.372	4.412	23.490	11.887	9.404	4.448	24.148	12.149
	(2.13)	(1.74)	(2.87)	(2.24)	(2.00)	(1.65)	(2.74)	(2.14)
(M-Y Ratio)	-8.056	-5.133	-19.943	-14.429	-8.232	-5.187	-21.140	-14.810
	(-1.99)	(-2.00)	(-2.28)	(-2.52)	(-1.90)	(-1.89)	(-2.26)	(-2.41)
$(\text{X-Y Ratio})^2$			-0.227	-0.141			-0.238	-0.145
			(-2.02)	(-1.69)			(-1.97)	(-1.63)
$(\text{M-Y Ratio})^2$			0.190	0.159			0.204	0.164
			(1.69)	(1.81)			(1.69)	(1.75)
R-square								
Within	0.509	0.506	0.517	0.511	0.500	0.497	0.508	0.502
Between	0.916	0.974	0.887	0.972	0.923	0.973	0.896	0.971
Overall	0.627	0.642	0.626	0.646	0.619	0.631	0.619	0.635
No. of Obs	255	255	255	255	254	254	254	254
Hausman#		4.130		5.640		3.330		4.850
Prob.		0.389		0.465		0.505		0.563

Note: Figures in parenthesis represent the t-statistic.

refers to Hausman specification test

Table 3B: Inflation Rate (based on GDP deflator) with dummies

	Dependent Variable: Inflation Rate (GDP Deflator)							
	Model 1		Model 2		Model 3		Model 4	
	FE	RE	FE	RE	FE	RE	FE	RE
(gM)	0.808	0.852	0.811	0.857	0.821	0.870	0.820	0.863
	(15.90)	(19.03)	(15.88)	(18.84)	(15.84)	(19.08)	(15.86)	(18.96)
(gQagr)	-3751.8	-3613.74	-3762.88	-3479.2	-3791.66	-3483.2	-3786.8	-3517.1
	(-5.67)	(-5.61)	(-5.65)	(-5.41)	(-5.60)	(-5.36)	(-5.61)	(-5.44)
(X-Y Ratio)	48.703	42.475	42.260	31.337	28.642	23.846	14.566	10.967
	(4.56)	(4.87)	(4.20)	(4.25)	(3.20)	(3.42)	(1.53)	(2.05)
M-Y Ratio)	-34.480	-41.315	-30.955	-37.095	-23.504	-28.019	-13.869	-16.442
	(-3.52)	(-4.50)	(-3.31)	(-4.53)	(-2.66)	(-3.93)	(-1.48)	(-2.87)
$(X\text{-}Y\ Ratio)^2$	-0.051	-0.053	-0.067	-0.097	-0.276	-0.246	-0.302	-0.239
	(-0.43)	(-0.62)	(-0.55)	(-1.13)	(-2.41)	(-2.78)	(-2.52)	(-2.79)
$(M\text{-}Y\ Ratio)^2$	0.044	0.073	0.063	0.138	0.229	0.279	0.230	0.273
	(0.36)	(0.80)	(0.49)	(1.53)	(2.09)	(3.05)	(2.11)	(3.12)
ND2(gQagr)	3740.30	3560.16	3729.03	3293.65	3663.91	3245.16	3660.50	3308.83
	(4.83)	(4.77)	(4.78)	(4.50)	(4.61)	(4.40)	(4.62)	(4.52)
ND2(X-Y Ratio)	-44.527	-39.077				-15.920		
	(-3.68)	(-4.03)				(-1.57)		
ND2(M-Y Ratio)	30.589	35.546				13.695		
	(2.55)	(3.62)				(1.76)		
D4(X-Y Ratio)			-36.926	-24.572				
			(-3.21)	(-3.05)				
D4(M-Y Ratio)			25.538	25.461				
			(2.21)	(3.13)				
D52(X-Y Ratio)					-17.784	-15.920		
					(-1.50)	(-1.57)		
D52(M-Y Ratio)					9.832	13.695		
					(0.92)	(1.76)		
D61(X-Y Ratio)							18.302	16.224
							(1.89)	(2.58)
D61(M-Y Ratio)							-9.714	-15.157
							(-1.15)	(-2.56)
R-square								
Within	0.580	0.580	0.580	0.570	0.560	0.560	0.567	0.561
Between	0.890	0.990	0.720	0.980	0.720	0.980	0.628	0.982
Overall	0.670	0.690	0.620	0.690	0.610	0.680	0.579	0.682
No. of Obs	255	255	255	255	255	255	255	255
Hausman#		7.130		10.200		7.180		6.330
Prob.		0.624		0.334		0.618		0.707

Note: Figures in parenthesis represent the t-statistic. # refers to Hausman specification test

ND2 refers to dummy for Non-hyperinflation economies, D4 refers to dummy for small economies, D52 dummy for South Asian economies, and D61 dummy for the high income economies.

Table 3C: Inflation Rate (based on CPI) with Dummies

Dependent Variable: Inflation Rate (Consumer Price Index)								
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	FE	**RE**	**FE**	**RE**	**FE**	**RE**	**FE**	**RE**
(gM)	0.843	0.886	0.847	0.890	0.856	0.903	0.855	0.896
	(15.55)	(18.58)	(15.54)	(18.40)	(15.53)	(18.63)	(15.54)	(18.50)
(gQagr)	-4020.8	-3885.2	-4032.1	-3754.4	-4060.9	-3765.7	-4055.8	-3803.1
	(-5.70)	(-5.67)	(-5.68)	(-5.49)	(-5.64)	(-5.46)	(-5.65)	(-5.54)
(X-Y Ratio)	48.752	43.536	42.380	32.240	29.493	24.927	14.975	11.599
	(4.27)	(4.69)	(3.94)	(4.12)	(3.06)	(3.33)	(1.47)	(2.04)
(M-Y Ratio)	-36.144	-42.732	-32.392	-38.490	-25.038	-29.422	-14.987	-17.465
	(-3.46)	(-4.38)	(-3.24)	(-4.42)	(-2.64)	(-3.85)	(-1.50)	(-2.86)
$(\text{X-Y Ratio})^2$	-0.054	-0.057	-0.071	-0.104	-0.288	-0.259	-0.311	-0.254
	(-0.42)	(-0.63)	(-0.55)	(-1.14)	(-2.35)	(-2.74)	(-2.43)	(-2.77)
$(\text{M-Y Ratio})^2$	0.048	0.080	0.068	0.148	0.246	0.295	0.247	0.290
	(0.36)	(0.82)	(0.50)	(1.54)	(2.10)	(3.02)	(2.13)	(3.11)
ND2(gQagr)	4018.195	3836.817	4006.004	3578.847	3955.964	3548.126	3956.390	3619.682
	(4.86)	(4.83)	(4.81)	(4.60)	(4.68)	(4.53)	(4.69)	(4.65)
ND2(X-Y Ratio)	-44.554	-39.884						
	(-3.43)	(-3.85)						
ND2(M-Y Ratio)	32.032	36.439						
	(2.49)	(3.48)						
D4(X-Y Ratio)			-36.921	-24.953				
			(-2.99)	(-2.90)				
D4(M-Y Ratio)			26.646	25.999				
			(2.15)	(3.00)				
D52(X-Y Ratio)					-18.081	-16.534		
					(-1.43)	(-1.53)		
D52(M-Y Ratio)					10.336	14.212		
					(0.91)	(1.72)		
D61(X-Y Ratio)							18.637	17.025
							(1.80)	(2.53)
D61(M-Y Ratio)							-10.599	-15.886
							(-1.17)	(-2.52)
R-square								
Within	0.57	0.57	0.57	0.56	0.56	0.55	0.56	0.55
Between	0.91	0.99	0.77	0.98	0.76	0.98	0.69	0.98
Overall	0.67	0.68	0.63	0.68	0.61	0.67	0.59	0.67
No. of Obs	254	254	254	254	254	254	254	254
Hausman#		5.62		8.39		5.99		5.09
Prob.		0.7777		0.4955		0.7411		0.8267

Note: Figures in parenthesis represent the t-statistic. # refers to Hausman specification test

ND2 refers to dummy for Non-hyperinflation economies, D4 refers to dummy for small economies, D52 dummy for South Asian economies, and D61 dummy for the high income economies.

Appendix A

The data series and their sources:

The data is taken from the 'World Development Indicators CDROM' of the World Bank and 'Handbook of Statistics on Indian Economy' published by the Reserve Bank of India[33]. The variables used in the analysis are inflation rate (based on GDP deflator and consumer price index), exchange rate with respect to U.S. dollar, growth of money stock, interest rate, real agricultural value added, real and nominal government expenditure, fuel imports, public debt, foreign direct investment, gross domestic product (real and nominal), and the openness variables. The variables used in the analysis were *(source: World Bank, World Development Indicators – CDROM and RBI, 2001):*

Agriculture, value added (constant LCU[34]) Agriculture covers forestry, hunting, and fishing as well as crops, and livestock. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 2. Data are in constant local currency.

Exports of goods and services (as % of GDP) Included is the value of merchandise, freight, insurance, travel, and other non-factor services. Factor and property income (formerly called factor services), such as investment income, interest, and labor income, is excluded.

GDP at market prices (constant LCU) Data are in constant local currency.

GDP at market prices (current LCU) Data are in current local currency.

GDP deflator (base year varies by country): GDP deflator is defined as the price index that measures the change in the price level of GDP relative to real output. It is calculated using GDP in current and constant 1987 local currency.

Imports of goods and services (as % of GDP): Included is the value of merchandise, freight, insurance, travel, and other non-factor services. Factor and property income (formerly called factor services), such as investment income, interest, and labor income, is excluded.

Inflation, consumer prices (annual %) Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services. In general, a Laspeyres index formula is used.

Inflation, GDP deflator (annual %) Inflation as measured by the annual growth rate of the GDP implicit deflator. GDP implicit deflator measures the average annual rate of price change in the economy as a whole for the periods shown.

[33] For some of the missing data series relating to the Indian economy.

[34] LCU refers to local currency units.

Money and quasi money (M2) (current LCU) Money and quasi money comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition is frequently called M2; it corresponds to lines 34 and 35 in the International Monetary Fund's (IMF) International Financial Statistics (IFS). Data are in current local currency.

Money and quasi money growth (annual %) Average annual growth rate in money and quasi money. Money and quasi money comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition is frequently called M2; it corresponds to lines 34 and 35 in the International Monetary Fund's (IMF) International Financial Statistics (IFS). The change in the money supply is measured as the difference in end-of-year totals relative to the level of M2 in the preceding year.

Official exchange rate (LCU per US$, period average) Official exchange rate refers to the actual, principal exchange rate and is an annual average based on monthly averages (local currency units relative to U.S. dollars) determined by country authorities or on rates determined largely by market forces in the legally sanctioned exchange market.

Trade (% of GDP) Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.

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