# Finance-Growth-Crisis Nexus in India: Evidence from Cointegration and Causality Assessment

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# FINANCE-GROWTH-CRISIS NEXUS IN INDIA: EVIDENCE FROM COINTEGRATION AND CAUSALITY ASSESSMENT*

## 1. Introduction

Since the influential works of McKinnon (1973) and Shaw (1973) were published, the finance-growth nexus – how financial development and output growth interact with each other – has been extensively investigated but the empirical findings on this issue have not been reconciled yet, i.e., either finance→output or output→finance or finance↔output (bidirectional). Meanwhile, as more economies – in particular those known as emerging economies – have been increasingly exposed to severe financial disturbances over the last few decades, financial crisis has been highlighted as one of the important topics in the literature. This paper attempts to integrate these two issues or to examine the 'finance-growth-crisis' nexus in India – the second largest emerging economy. As the Chakravarty Committee Report (Report of the Committee to Review the Working of the Monetary System) (Reserve Bank of India, 1985) was announced in April 1985, India was in the process of (partial) financial liberalization experiencing credit boom and high output growth over the late 1980s. Then, the severe crisis hit India in early 1991. It has been claimed that while India's 1991 crisis was triggered by several external- and internal shocks, the origins of the crisis can be traced back to prolonged macroeconomic imbalances (Joshi and Little, 1996; Nayyar, 1996)[1]. At the same time, as the structural break literature was put forward by Perron (1989), the presence of structural break in the growth process (GDP series) is rationally assumed. In fact, the 1991 crisis is widely considered

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[1] There were such external and internal shocks as the oil price increase associated with the first Gulf War, the collapse of the USSR (India's main trade partner) and prolonged uncertainty in India's politics over the late 1980s and early 1990s.

as the crucial turning point for India, that is, a structural change in India's economic development may exist around the year 1991[2]. Moreover, inspired by the fact that India's financial system has been heavily regulated, we are also concerned with financial repression in line with Demetriades and Luintel (1997).

Two inherent problems in the literature are pointed out. First, although the relationship between financial deepening and economic growth potentially relates to the incidence of financial crisis, the trivariate linkage between finance, output and crisis has not been addressed yet, especially in the framework of cointegration and Granger causality. Second, in the empirical literature of the finance-growth nexus, the leading evidence – finance exerts a positive impact on output growth – has been drawn from cross-country and panel data models. These models, however, implicitly presume homogeneity in different countries' growth patterns and thus mask country-specific factors in estimation (Demetriades and Hussein, 1996; Luintel and Khan, 1999).

The goal of this paper is to analyze the cointegration and causality between financial development, economic growth and financial crisis in India through the techniques of the vector error correction model (VECM) and autoregressive distributed lag (ARDL)[3]. This paper contributes to the literature as follows. First, we conduct a single country assessment focusing on India's finance-growth-crisis nexus. Hence, the evidence from our study – that fully takes India's own conditions into estimation – will be more applicable to India than the evidence from cross-country and panel data studies that seek a single generalized result by mixing several countries' data series. Second, the use of VECM and ARDL, which are based on different concepts of cointegration (i.e., Johansen, 1988; Pesaran *et al.*, 2001), is an innovation that can attach more robustness to our analysis. Third, most importantly, we extend the finance-growth nexus – the empirical results on this topic have not been reconciled yet – to the finance-growth-crisis nexus. By doing so, more accurate estimates on India's finance-growth nexus will be detected, as the interaction between finance, output and crisis must be crucial to determine the effect of

[2] An increasingly agreed view is that India's growth transition began in the early 1980s rather than after the crisis of 1991 (see Rodrik and Subramanian, 2005). However, we assume that India's economic growth has a structural change around the year 1991 in the framework of our quarterly data series (1982Q1 to 2007Q4) that have more observations and less time span than annual data series do (e.g., 1950 to 2007).

[3] Using both ARDL and VECM techniques, Enisan and Olufisayo (2009) examined the causal link between stock market development and economic growth in African countries.

finance/output on each of them. That is, how does financial crisis – as one of the endogenous variables in the system – exhibit a background effect on the finance-growth nexus that can be either finance→output or output→finance or finance↔output (bilateral)? Also, India's experiences motivate us to look at how both finance and output influence crisis (finance→crisis and output→crisis) having either a positive or negative impact. In particular, as a financial boom over the late 1980s typically preceded India's 1991 crisis, we predict that the increasing level of financial development crucially causes financial crisis.

The remainder of the present paper is structured as follows. In Section 2, the literature review is presented. In Section 3, the underlying variables of the economic indicator (EG) and three summary indicators are described. Econometric models and procedures are outlined in Section 4. Our findings are reported and discussed in Section 5, and conclusion and policy implication are given in the end. For our analysis, we used the data from the IMF's International Financial Statistics (IFS), the World Bank's Financial Structure Dataset (FSD) and World Development Indicators (WDI), and the publication of the Reserve Bank of India (India's central bank).

## 2. Literature review

Initially suggested by Schumpeter (1911) a century ago and advanced by McKinnon (1973) and Shaw (1973), it has been a general concept that financial development is vital for higher economic growth. This finance-led view is further supported by the endogenous growth literature that explicitly incorporates financial intermediation into growth models (see Greenwood and Jovanovic, 1990; Bencivenga and Smith, 1991). In contrast, economists like Robinson (1952) contend that economic growth creates the demand for financial services and the financial system responds automatically to that demand. For settling this theoretical debate, a number of empirical studies have been conducted. On the one hand, in the multi-country assessment, there has been a methodological controversy between cross-country and panel data studies – initiated by King and Levine (1993) – and time series ones – pioneered by Demetriades and Hussein (1996)[4]. On the other hand, the single-country analysis,

[4] Some empirical studies have questioned the linear specification and suggested the nonlinearity of finance-growth nexus in the framework of cross-country analysis (see Deidda and Fattouh, 2002).

in which the time series method is dominant and to which our analysis belongs, empirical evidence of finance-growth nexus in each developing country, especially for causal direction, has been mixed. That is the case for India as well. For example, Demetriades and Hussein (1996), Demetriades and Luintel (1997) and Luintel and Khan (1999) discovered a bidirectional relationship (finance↔output) in India. More recently, Singh (2008) also detected the presence of bidirectional causality. Differently, Bell and Rousseau (2001) used various measures of macroeconomic development and financial development and revealed a unilateral causality of finance→output. Likewise, Bhattacharya and Sivasubramanian (2003) investigated the causal link between financial development (M3) and economic growth (nominal GDP) and found out the causation of finance→output. Moreover, Arestis *et al*. (2002) reported that financial development was promoted by economic growth but there was no feedback (output→finance) in India.

As far as India's financial profile is concerned, we highlight the emergence of the New Financial Architecture (NFA). The NFA refers to

> "the integration of modern day financial markets with the era's light government regulation" (Crotty, 2009).

Under such a global environment, financial liberalization was initiated, or the extent of financial repression was lessened by deregulating interest rate ceilings, lowering reserve requirements and reducing the volume of directed credit in developing economies over the last two decades. Meanwhile, although financial development – as the achievement of financial liberalization – contributed to higher economic growth, its favorable effects have been questioned due to increasing financial fragility and repeated crisis episodes in emerging economies (e.g., the Mexican 1994-1995 crisis and the Asian 1997 crisis). In fact, there are two different strands of the literature on the impact of financial development on economic growth (Loayza and Rancière, 2006). As aforementioned, the finance-growth nexus literature emphasizes a positive effect of financial depth as measured by, for instance, private domestic credit and liquid liabilities. On the other hand, the financial crisis literature finds that monetary aggregates – such as domestic credit – are among the best predictors of both banking and currency crises and resultant economic downturns (Demirgüç-Kunt and Detragiache, 1998; Kaminsky and Reinhart, 1999). India is also not free from these arguments.

As mentioned above, India initiated (partial) financial liberalization and experienced financial boom and high economic growth during the late 1980s. And this process ended up with the severe financial crisis in early 1991. Aftermath of the 1991 crisis, the full-fledged financial reforms started, receiving a special attention as part of the New Economic Policy (NEP). While financial deepening extended together with high economic achievements during the post-crisis period, India has been increasingly exposed to instability (e.g., in the form of high inflation) as compared with in the heavily controlled and less financially opened past.

## 3. Data

### *3.1 Use of Quarterly Frequency Data*

One important departure of this study is the use of quarterly frequency data[5]. Two reasons are given as follows. Firstly, in performing time series analysis, more observations can help obtain more plausible estimates. Secondly, as discussed below in *Financial Crisis Indicator*, the quarterly volatility in each elementary variable is calculated to produce the financial crisis indicator (FC). We consider that quarterly frequency is the best time size to take volatility into estimation. If monthly volatility is used, it is constantly fluctuating. Likewise, if annual volatility is computed, it is less fluctuating, or actually is a pulse dummy highlighting the crisis-hit year only.

### *3.2 Disaggregation Procedure for GDP Series*

Although our analysis bases on quarterly time series data, India does not provide the quarterly GDP series that entirely cover the sample period 1982Q1 to 2007Q4. Therefore, we disaggregate India's annual nominal- and real *per capita* GDP (nominal GDP deflated by the GDP deflator and the population) series to quarterly ones through the method developed by Chow and Lin (1971), and use thus computed quarterly figures in estimation. Nominal GDP series

[5] It has been pointed out that quarterly frequency data are usually associated with short-run cyclical fluctuations of the economy. Hence, if a series exhibits a prominent seasonality, it is removed from the series through proper statistical procedures.

are used as a deflator in calculating several elementary variables of financial development and financial repression, and the volatility in nominal GDP is measured as one of the elementary variables of financial crisis (see Appendixes 2 to 4). Likewise, we compute quarterly real *per capita* GDP and take its logarithm as the economic growth indicator (EG). In conducting the disaggregation through the Chow and Lin method, we need to take actually measured quarterly data series as the indicator(s) into calculation; those indicators are necessary to give proper fluctuations – based on real conditions – to quarterly GDP series. For this end, we select both industrial production (IFS line 66) and export volume (IFS line 70), both of which (and GDP series) are flow variables.

### *3.3 Summary Indicators*

In subsequent discussion, we outline how to produce three summary indicators of the financial development indicator (FD), financial crisis indicator (FC) and financial repression indicator (FR), respectively, through the principal component approach. The use of the principal component approach to making summary indicators was pioneered by Demetriades and Luintel (1997) and followed by Ang and McKibbin (2007). For conserving space, all information relevant to creating summary indicators is not presented but is given on request. The plots of the summary indicators are given in Appendix 1.

### *3.4 Financial Development Indicator*

One issue in the empirical literature is that there is no single indicator that sufficiently captures all aspects of financial development. Accordingly, most studies separately examine the relationship between economic growth (mostly real *per capita* GDP) and each of several financial development variables (e.g., liquidity liabilities (M3) and domestic credit provided to the private sector). Another issue is that banking and stock market – two major components of financial development – have been independently assessed in the literature. Such studies as Levine and Zervos (1998) and Arestis *et al.* (2001) investigated the effect of stock market development on output growth. Meanwhile, there are few studies considering financial development as a combined phenomenon consisting of banking and stock market, despite the increasing influence of the latter in emerging economies like India. Considering these issues, we argue that financial development – as a single phenomenon – should be measured by combining several elements. Then, the five elementary variables of financial development, which are commonly used in the literature, are selected and integrated so as to make the financial development indicator (FD) (see Appendix 2)[6]. The ratio of money supply to GDP (MTG) is picked up to capture the degree of financial depth in the simplest manner. We are also concerned with the financial size- and activity (liquidity) measures (BATG, PCTG, SKTG and SVTG) suggested by Beck *et al.* (1999). With these measures, the impacts of two financial channels (banking sector and stock market) and their two aspects (size and activity) are approximated.

### *3.5 Financial Crisis Indicator*

In creating the financial crisis indicator (FC), we suggest the following two points. First, financial crisis should be measured by a rich set of macroeconomic indicators. The rationale is that although financial crises are generally classified into currency- and banking crises, we consider financial crisis as a combined macroeconomic phenomenon consisting of both currency and banking crises (Kaminsky and Reinhart, 1999); in fact, each type of crisis is influenced by several macroeconomic factors[7]. As mentioned in *Introduction*, the fundamental causes of India's 1991 crisis were originated to augmented macroeconomic imbalances over the late 1980s. Second, obtaining a hint from the ongoing debate in the macroeconomic volatility literature, we argue that, while financial fragility – as a continuous phenomenon – can be measured as changing volatility in an economy, financial crisis is identified as an extreme volatility in that process[8,9]. Based on these arguments, we calculate the volatility in each of 16 elementary variables of financial

[6] In this paper, a summary indicator is made of several elementary variables.

[7] For selecting the elementary variables of financial crisis, we reviewed the 'leading indicators of crisis' or early warning system (EWS) literature pioneered by Kaminsky *et al.* (1998) and further developed by several IMF economists (e.g., Berg *et al.*, 2005).

[8] The macroeconomic volatility literature initially concerns the link between economic growth and volatility (e.g., Ramey and Ramey, 1995) and recently was extended to studying that linkage in terms of globalization, that is, growing international trade and financial integration (e.g., Kose *et al.*, 2006).

[9] *"Many of these (emerging) economies have experienced rapid growth but have also been subject to high volatility, most prominently in the form of severe financial crises that befell many of them during the last decade and a half"* (Kose *et al.*, 2006).

crisis (see Appendix 3) by the squared returns. In case of real exchange rate (ER), for example, its volatility is computed as follows:

$$ER_t^* = \log ER_t$$

$$\Delta ER_t^* = ER_t^* - ER_{t-1}^*$$

$$\Delta \overline{ER_t^*} = Mean\ of\ \Delta ER_t^*$$

$$X_t^2 = (\Delta ER_t^* - \Delta \overline{ER_t^*})^2\ or\ [\log(ER_t / ER_{t-1})]^2$$

Subsequently, we compute a 4-quarter rolling average of $X_t^2$ because the volatility values in level are too uneven to find more correlations among financial crisis variables for making FC. Finally, as illustrated in Appendix 1(c), the plot of FC exhibits its peak or extreme volatility over the crisis period 1990 to 1991.

### *3.6 Financial Repression Indicator*

Financial repression takes the form of such financial distortions as interest rates controls (ceilings), reserve requirements and directed credit. McKinnon (1993) defines financial repression as:

> "When governments tax (through reserve requirements) and otherwise distort their domestic capital markets (through interest controls and directed credit), the economy is said to be financially repressed".

Another argument is that a high degree of financial repression is associated with high inflation or seigniorage (Bencivenga and Smith, 1992). Moreover, we consider that, as the volume of credit provided to the government increases crowding out the credit provided to the private sector, the extent of financial repression is intensified. Based on these arguments, we select eight elementary variables of financial repression (see Appendix 1(d)).

## 4. Methodology

### *4.1 Granger Causality*

We provide the basic models that are expressed as follows:

$$EG_i = f(FD_i, FC_i, FR_i) \tag{1}$$

$$FD_i = f(EG_i, FC_i, FR_i) \tag{2}$$

$$FC_i = f(EG_i, FD_i, FR_i) \tag{3}$$

In the above equations, $EG_i$ is the economic growth indicator as measured by the logarithm of real *per capita* GDP; $FD_i$, $FC_i$ and $FR_i$ are the financial development, financial crisis and financial repression indicators, respectively. In each equation, $FR_i$ is treated as an exogenous $I(1)$ variable since it is a policy variable[10]. Estimating Equations 1 and 2, we address a conventional topic of finance-growth nexus: whether the causation runs finance→output or output→finance or bilaterally (finance↔output). We are also concerned with how crisis and repression influence output and finance. Another important issue is given by Equation 3, through which the causalities between financial crisis and other underlying variables are assessed.

We conduct the cointegration and Granger causality analysis through the methods of vector error correction model (VECM) and autoregressive distributed lag (ARDL). According to Engle and Granger (1987), cointegrated variables in the vector autoregression (VAR) system must have an error correction representation in which an error correction term (ECT) is incorporated into a model. In the context of assessing the finance-growth nexus, while a simple VAR estimation just indicates that one variable Granger causes the other variable without information of causal direction (e.g., whether finance has a positive or negative effect on output), both VECM and ARDL show a definite direction through the sign of each underlying variable's coefficient in the cointegrating space. Moreover, VECM imposes a strict condition that all underlying variables be integrated of order 1 ($I(1)$), whereas ARDL can be performed even with the mixture of $I(0)$ and $I(1)$ (Pesaran and Pesaran, 2009). Thus, these two techniques stand on different fundamentals of cointegration. Moreover, since the structural break literature was initiated by Perron (1989), the accuracy of conventional unit root and Johansen cointegration tests (i.e., the VECM estimation) has been challenged because the presence of structural break can mimic the unit root stationary autoregressive process. Therefore, using both VECM and ARDL can attach more robustness to the analysis.

### *4.2 Initial Procedures*

As the first step of the cointegration analysis, both the Augmented Dickey-Fuller (ADF) test (Said and Dickey, 1984) and the Phillips

[10] For the cointegration analysis with a weakly exogenous $I(1)$ variable, see Pesaran *et al.* (2000).

and Perron (PP) test (Phillips and Perron, 1988) are implemented. Since the element of structural break is assumed in our analysis, we also conduct the test of unit root with a structural break suggested by Perron (1989) – that takes a known break date into calculation – while predetermining the break date through the Bai and Perron (1998; 2003) test[11]. After all the underlying variables are confirmed as $I(1)$, the Johansen (1988) cointegration test is performed to determine the number of cointegrating vectors ($r$). In conducting the Johansen test, we follow the approach suggested by Pesaran and Pesaran (2009) that allows us to take the element of structural break as the deterministic component as well as an exogenous $I(1)$ variable into estimation[12].

### *4.3 Vector Error Correction Models*

The VECMs for our analysis of India's finance-growth-crisis nexus is formulated as follows:

$$\begin{aligned}\Delta EG_t &= \alpha_1 ECT_{t-1} + \sum_{j=1}^{p-1} \theta_{11} \Delta EG_{t-j} + \sum_{j=1}^{p-1} \theta_{12} \Delta FD_{t-j} \\ &+ \sum_{j=1}^{p-1} \theta_{13} \Delta FC_{t-j} + \sum_{j=1}^{p-1} \theta_{14} \Delta FR_{t-j} + \theta_{15} SGD_t \\ &+ \theta_{16} PCD_t + \theta_{17} SBGD_t + inpt + u_{1t} \qquad (4)\end{aligned}$$

[11] It has been pointed out that, if a structural break exists in time series data, conventional unit root tests (i.e., the ADF and PP tests) lose their estimation power (Perron, 1989; 2006). And there are several break tests (e.g., Lumsdaine and Papell, 1997; Lee and Strazicich, 2003) which are autoregressive models providing unit root test statistics and endogenously determining the break date. On the other hand, the Bai and Perron (BP) test is not a unit root test but specifies multiple breaks comprising not only autoregressive variables but also other variables. In our opinion, the break dates given by those autoregressive tests are less informative than the dates given by the BP test of a multivariate model. Meanwhile, the BP test is not associated with the issue of unit root with a structural break(s). Considering these two points, we take the above mentioned two-step procedure: (1) estimating the break date through the BP test; and (2) conducting the Perron test that comprises the predetermined break date.

[12] Furthermore, the accuracy of the cointegration test with a structural break(s) has been also questioned in the literature (Gregory and Hansen, 1996). In the context of our system-based analysis, such approaches as Johansen *et al.* (2000), Saikkonen and Lütkepohl (2000) and Pesaran and Pesaran (2009) can comprise the element of structural break – in the form of a level dummy – into the cointegration analysis. Among these three, only the Pesaran and Pesaran (2009) approach offers us the estimation with an exogenous $I(1)$ variable.

$$\Delta FD_t = \alpha_2 ECT_{t-1} + \sum_{j=1}^{p-1} \theta_{21} \Delta EG_{t-j} + \sum_{j=1}^{p-1} \theta_{22} \Delta FD_{t-j} + \sum_{j=1}^{p-1} \theta_{23} \Delta FC_{t-j} + \sum_{j=1}^{p-1} \theta_{24} \Delta FR_{t-j} + \theta_{25} SGD_t + \theta_{26} PCD_t + \theta_{27} SBGD_t + inpt + u_{2t} \quad (5)$$

$$\Delta FC_t = \alpha_3 ECT_{t-1} + \sum_{j=1}^{p-1} \theta_{31} \Delta EG_{t-j} + \sum_{j=1}^{p-1} \theta_{32} \Delta FD_{t-j} + \sum_{j=1}^{p-1} \theta_{33} \Delta FC_{t-j} + \sum_{j=1}^{p-1} \theta_{34} \Delta FR_{t-j} + \theta_{35} SGD_t + \theta_{36} PCD_t + \theta_{37} SBGD_t + inpt + u_{3t} \quad (6)$$

where Δ denotes to the first difference operator, and *ECT* is the error-correction term; for example, in Equation 4, $ECT = \beta_{11}EG_{t-1} + \beta_{12}FD_{t-1} + \beta_{13}FC_{t-1} + \beta_{14}FR_{t-1}$ in which $\beta_{ij}$'s are the elements of the cointegrating vector, and the ECT coefficient ($\alpha$) is expected to have a negative sign. Subsequently, dummy variables included are elucidated. First of all, for avoiding serial correlation, we allocate SGD (the shock in economic growth dummy), which takes the value of one for negative EG growth periods otherwise zero. PCD is the pre-crisis dummy that takes the value of one for 1990Q1 to 1990Q4 and zero for all other periods. And the allocation of SBGD (the structural break in economic growth dummy) is discussed below in *Bai and Perron Test*. In order to give interference in our analysis, three types of the causality test are conducted. The first test is the short-run Granger causality test that examines the null of $H_0$: all $\theta_{ij}$'s = 0 so as to examine the joint significance of short-run dynamics. The second test is the weak exogeneity test in which the null of $H_0$: $\alpha_j = 0$. Indeed, the weak exogeneity test calculates the significance of the ECT coefficient and thus presents the evidence of long-run causality. And the third test is the strong exogeneity test that imposes the strongest restriction of $H_0$: all $\theta_{ij}$'s = $\alpha_j$ = 0 in each VECM. Although not distinguishing between the short-run- and long-run causalities, the strong exogeneity test indicates the overall causality in the system (see Charemza and Deadman, 1997). These causality tests are based on chi-square statistics from the Wald test.

### *4.4 Autoregressive Distributed Lag Models*

The Johansen (1988) cointegration test is based on a restrictive assumption that all the underlying variables are integrated of order one or $I(1)$. This assumption is crucial since a mixture of $I(0)$ and $I(1)$ regressors makes standard statistical inference invalid. On the other hand, the ARDL approach suggested by Pesaran *et al.* (2001) can be applied even when underlying variables have different orders of integration. The ARDL frameworks for EG, FD and FC as the dependent variables are presented by the following error correction models (ECMs):

$$\Delta EG_t = \alpha_4 ECT_{t-1} + \sum_{j=1}^{p-1} \theta_{41} \Delta EG_{t-j} + \sum_{j=1}^{p-1} \theta_{42} \Delta FD_{t-j} + \sum_{j=1}^{p-1} \theta_{43} \Delta FC_{t-j} + \sum_{j=1}^{p-1} \theta_{44} \Delta FR_{t-j} + \theta_{45} \Delta SGD_t + \theta_{46} \Delta PCD_t + \theta_{47} \Delta SBGD_t + inpt + u_{4t} \tag{7}$$

$$\Delta FD_t = \alpha_5 ECT_{t-1} + \sum_{j=1}^{p-1} \theta_{51} \Delta EG_{t-j} + \sum_{j=1}^{p-1} \theta_{52} \Delta FD_{t-j} + \sum_{j=1}^{p-1} \theta_{53} \Delta FC_{t-j} + \sum_{j=1}^{p-1} \theta_{54} \Delta FR_{t-j} + \theta_{55} \Delta SGD_t + \theta_{56} \Delta PCD_t + \theta_{57} \Delta SBGD_t + inpt + u_{5t} \tag{8}$$

$$\Delta FC_t = \alpha_6 ECT_{t-1} + \sum_{j=1}^{p-1} \theta_{61} \Delta EG_{t-j} + \sum_{j=1}^{p-1} \theta_{62} \Delta FD_{t-j} + \sum_{j=1}^{p-1} \theta_{63} \Delta FC_{t-j} + \sum_{j=1}^{p-1} \theta_{64} \Delta FR_{t-j} + \theta_{65} \Delta SGD_t + \theta_{66} \Delta PCD_t + \theta_{67} \Delta SBGD_t + inpt + u_{6t} \tag{9}$$

The ECT in Equation 7, for example, takes the form of: $ECT = \beta_{41}EG_t + \beta_{42}FD_t + \beta_{43}FC_t + \beta_{44}FR_t + \beta_{45}SGD_t + \beta_{46}PCD_t + \beta_{47}SBGD_t + inpt$. The ARDL estimation provides $(p+1)^k$ number of regressions, where $p$ is the maximum number of lags to be used and $k$ is the number of variables in the ARDL equation. Since this study uses quarterly series, the maximum lag is initially set at $p = 4$. At the first stage, we need to conduct the bounds test – the counterpart of the Johansen cointegration test – that computes $F$-statistics to confirm the existence of long-run cointegrating relationships between the underlying variables irrespective of whether these variables are $I(0)$ or $I(1)$ (Pesaran and Pesaran, 2009). At the second stage, the optimal lag order for each variable is set. Finally, three types of the causality test, which are suggested in the VECM analysis, are carried out for each ARDL model.

### 4.5 Bai and Perron Test

As mentioned above in *Introduction*, the element of structural break is mattered in this study. While a structural break(s) in each of underlying variables (EG, FD and FC) can be computed, we argue that the break in EG (real *per capita* GDP) is more influential than those in FD and FC. Hence, the structural break in growth dummy (SBGD) is calculated by the multiple structural break test developed by Bai and Perron (1998; 2003) (hereafter referred to as the BP test)[13]. The BP test specifies multiple structural changes in a linear regression model estimated by least squares, treating the dates of structural break as unknown and endogenous events. Therefore, the rationale for performing the BP test is that it allows us to determine break points statistically and objectively, not setting the number of breaks and break dates based on *a priori* information.

We conduct the BP test through the following unrestricted vector autoregression model (EG-VAR) in which EG is the dependent variable:

$$\begin{aligned} EG_t = {} & \sum_{j=1}^{p} \gamma_{11} EG_{t-j} + \sum_{j=1}^{p} \gamma_{12} FD_{t-j} \\ & + \sum_{j=1}^{p} \gamma_{13} FC_{t-j} + \sum_{j=1}^{p} \gamma_{14} FR_{t-j} + \gamma_{15} SGD_t \\ & + \gamma_{16} PCD_t + inpt + u_{1t} \end{aligned} \tag{10}$$

To eliminate serial correlation in calculation, the EG-VAR includes both SGD and PCD (see *Vector Error Correction Models*). The BP test estimation starts with setting the lag order of Equation 10. Checking the results of the lag order selection test, we choose the four-lag order[14]. Subsequently, we produce different SBGDs on the basis of one to three-break results reported in Table 1. For example, based on the one-break result, we plot SBGD as illustrated in Figure 1. Both of the sum of squared residuals and SBC (Schwarz Bayesian Criterion), which are the selection criteria suggested by Bai and Perron (2003), choose the 1-break result. However, we look for an effective number of break(s) that is not necessarily selected

[13] This method of distributing the structural break dummy is hinted by Verma and Wilson (2005) who detect a structural break in India's annual GDP series around 1989 with the Perron and Vogelsang (1992) test and allocate 0 and 1 dummies assuming the year 1989 as the break point.

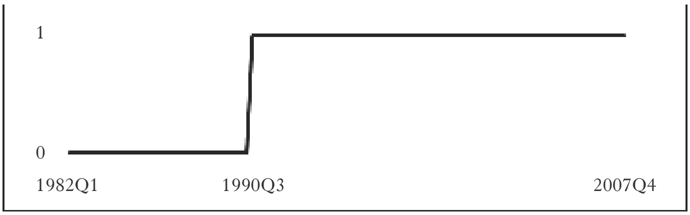
[14] To conserve the space, all the results relevant to the BP test are not presented but are given on request.

by the two criteria. Hence, actually adding each of one to three-break SBGDs into all VECM and ARDL assessments, we detected that the one-break result (1990Q3) is the best, as it provides most significant estimates to our analysis.

TABLE 1 - *Bai and Perron Test Results (1982Q1 to 2007Q4)*

| No. of Break(s) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Best break point(s) | 1990Q3 | 1990Q3 | 1988Q3 | — |
| | | 1997Q1 | 1994Q2 | |
| | | | 1999Q3 | |
| Selection Criterion | | | | |
| Sum of squared residuals | 0.00553 | 0.00282 | 0.00172 | — |
| SBC | -8.14423 | -7.97118 | -7.61710 | — |

FIGURE 1 - *India's SBGD (One Break)*




## 5. Empirical results

### *5.1 Unit Root and Cointegration Tests*

Since the space is limited, we provide only the four-lag order results of the ADF and PP unit root tests in Table 2. The statistics show that all EG, FD, FC and FR are estimated as $I(1)$. Next predetermining the break date (1990Q3) through the BP test, we conduct the Perron (1989) test of unit root with a structural break for which three models are computed. The results in Table 3 report that albeit exposed to a structural break, all the underlying variables are estimated as $I(1)$. Then we shift to the Johansen cointegration test (with unrestricted intercept and no trend) to detect cointegrating relationships among the underlying variables while treating FR as an exogenous $I(1)$ variable – since FR is regarded as a policy variable – in the cointegrating vector[15]. Since the Johansen test is sensitive to the lag length, we initially carry out the lag selection test while setting the maximum lag order at $k = 4$. The AIC select four lags, whereas the SBC select one lag. From these results, the AIC selection of $k = 4$ is chosen so as to avoid serial correlation in the analysis[16]. In Table 4, both the maximum eigenvalue and trace statistics show that there is a single cointegration ($r = 1$) among EG, FD and FC at the 5% level.

TABLE 2 - *Unit Root Test Results (k = 4)*

| | ADF Test | | PP Test | |
|---|---|---|---|---|
| | Inpt. & No Trend | Inpt. & Trend | Inpt. & No Trend | Inpt. & Trend |
| EG | 2.360 | 0.209 | 3.005§ | 0.152 |
| ΔEG | -3.194* | -4.000* | -11.229* | -12.265* |
| FD | 2.550 | 1.035 | 2.068 | -1.039 |
| ΔFD | -3.448* | 4.026* | -15.863* | -17.120* |
| FC | -2.100 | -2.295 | -2.418 | -2.617 |
| ΔFC | -5.686* | -5.694* | -7.084* | -7.134* |
| FR | -0.027 | -1.880 | -0.515 | -2.371 |
| ΔFR | -3.922* | -4.194* | -16.108* | -16.913* |

*Notes*: (*) 5% level of significance. (§) The $H_0$ cannot be rejected at the 1% level.

TABLE 3 - *Perron Test Results (Break Date: 1990Q3)*

| | Model A | Model B | Model C |
|---|---|---|---|
| | Crash | Changing growth | Crash & changing growth |
| EG | -0.252∓ | -1.270 | -1.753 ∓ |
| ΔEG | -8.713** ∓ | -3.691* | -8.860** ∓ |
| FD | 1.453 | 0.964 | 0.942 |
| ΔFD | -5.463** | -10.03** | -10.01** |
| FC | -2.565 | -4.223§ | -2.821 |
| ΔFC | -7.117** | -6.435** | -7.076** |
| FR | -1.204 | -3.810§ | -3.848 |
| ΔFR | -5.724** | -5.713** | -5.694** |

*Notes*: (**) 1% and (*) 10% level of significance. (§) The $H_0$ cannot be rejected at the 1% level. (∓) The appropriate number of lagged differences is selected by the Lagrange Multiplier test. For all others, it is given by the Ljung-Box test.

[15] Checking the results from two other cases of *restricted intercept and no trend* and *restricted trend and unrestricted intercept* as well, we have confirmed that the case of *unrestricted intercept and no trend* provides the best results.

[16] The results are provided on request.

Table 4 - *Johansen Cointegration Test Results (k = 4)*

| Null | Alternative | Trace | Maximum eigenvalue |
|---|---|---|---|
| $r = 0$ | $r = 1$ | 47.57* | 30.45* |
| $r <= 1$ | $r = 2$ | 17.12 | 14.20 |
| $r <= 2$ | $r = 3$ | 2.92 | 2.92 |

*Notes*: (*) 5% level of significance.

### *5.2 ARDL Procedures*

The ARDL analysis begins with the bounds test for each model at the lag order of four. The results in Table 5 reveal that there is no cointegrating relationship in EG-ARDL. Thus, the bounds test rejects the presence of a long-run causality in EG-ARDL where EG is the dependent variable. On the other hand, the *F*-statistics of both FD (3.526) and FC (3.225) locate between the 5% and 10% significance bounds (3.23 to 4.35 and 2.72 to 3.77), respectively. When the estimated statistic falls inside the critical value bounds, we need to check the results from the conventional unit root tests since the result is inclusive (Pesaran and Pesaran, 2009). As reported in Tables 2 and 3, the unit root test results have demonstrated that all the underlying variables are $I(1)$. Accordingly, the FD-ARDL and FC-ARDL only are estimated in the ARDL analysis. Next, while we seek the lag length of each underlying variable, both AIC and SBC provide us the lag selections that seem to cause serial correlation in both FD-ARDL and FC-ARDL. Therefore, the orders of the two models are set by us as (2, 4, 2, 2) for FD-ARDL (the sequence is: FD, EG, FC and FR) and (4, 1, 4, 0) for FC-ARDL (the sequence is: FC, EG, FD and FR), respectively.

Table 5 - *Bounds Test Results*

| D. Variable | *F*-Statistics | 10% bounds | | 5% bounds | |
|---|---|---|---|---|---|
| | | $I(0)$ | $I(1)$ | $I(0)$ | $I(1)$ |
| EG | 0.899 | 2.72 | 3.77 | 3.23 | 4.35 |
| FD | 3.526* | 2.72 | 3.77 | 3.23 | 4.35 |
| FC | 3.225* | 2.72 | 3.77 | 3.23 | 4.35 |

*Notes*: (*) 10 % level of significance. Critical values are from Pesaran *et al*. (2001).

### *5.3 Initial Analysis*

Due to the Johansen cointegration and ARDL bounds tests, the total of five models is estimated for India's finance-growth-crisis nexus. The diagnostic test statistics in Table 6 demonstrate that while some models exhibit the evidence of heteroscedasticity, non-normality and functional form problem, all the models pass the test of serial correlation at the 10% significance level or better; this means that our analysis is free from the problem of omitted variables. If heteroscedasticity is detected, the results are computed in terms of the White heteroscedasticity adjusted standard error. Table 7 presents the identified cointegrating vectors for economic growth, financial development and financial crisis together with $\alpha$ (ECT coefficient) that indicates the speed of adjustment from a deviation to long-run steady state. All ECT coefficients – except that of EG-VECM – are statistically significant with a negative sign, ranging within acceptable sizes. Subsequently, we look at the $\beta$ coefficients in the cointegrating vectors and identify such causal directions as: finance and output are positively correlated; financial crisis is positive to finance and negative to output; and financial repression is positive to output and negative to finance.

TABLE 6 - *Diagnostic Test Results (LM Version)*

| **Panel A:** VECM | | | |
|---|---|---|---|
| Test statistics | EG-VECM | FD-VECM | FC-VECM |
| Serial correlation | CHSQ(4) = 5.651 [.227] | CHSQ(4) = 2.357 [.670] | CHSQ(4) = 6.397 [.171] |
| Functional form | CHSQ(1) = 0.035 [.851] | CHSQ(1) = 0.125 [.724] | CHSQ(1) = 0.547 [.460] |
| Normality | CHSQ(2) = 14.850 [.001] | CHSQ(2) = 5.278 [.071] | CHSQ(2) = 120.955 [.000] |
| Heteroscedasticity | CHSQ(1) = 14.901 [.000] | CHSQ(1) = 0.001 [.893] | CHSQ(1) = 0.011 [.915] |
| **Panel B:** ARDL | | | |
| Test statistics | EG-ARDL | FD-ARDL | FC-ARDL |
| Serial correlation | — | CHSQ(4) = 4.616 [.329] | CHSQ(4) = 8.449 [.076] |
| Functional form | — | CHSQ(1) = 3.029 [.082] | CHSQ(1) = 11.328 [.001] |
| Normality | — | CHSQ(2) = 7.052 [.029] | CHSQ(2) = 85.014 [.000] |
| Heteroscedasticity | — | CHSQ(1) = 9.207 [.002] | CHSQ(1) = 0.313 [.576] |

*Notes*: *p*-value is given in [ ].

TABLE 7 - *Identified Cointegrating Vectors*

**Panel A:** VECM

| Model | Cointegrating vector | $\alpha$ |
|---|---|---|
| EG-VECM | $ECT = 1.000EG - 0.868FD + 0.256FC - 0.807FR$ | -0.009 |
| FD-VECM | $ECT = -1.152EG^{*} + 1.000FD - 0.295FC^{*} + 0.930FR$ | -0.990* |
| FC-VECM | $ECT = 3.905EG^{***} - 3.390FD^{*} + 1.000FC - 3.153FR^{*}$ | -0.195* |

**Panel B:** ARDL

| Model | Cointegrating vector | $\alpha$ |
|---|---|---|
| EG-ARDL | — | — |
| FD-ARDL | $ECT = -1.058EG^{*} + 1.000FD - 0.155FC^{***} + 0.874FR$ | -0.118*** |
| | $- 0.107SGD - 0.154PCD - 0.001SBEG + 1.956^{***}$ | |
| FC-ARDL | $ECT = 5.294EG - 3.813FD + 1.000FC - 0.950FR$ | -0.207** |
| | $+ 0.700SGD + 1.693PCD^{**} + 0.824SBGD^{***} - 9.323$ | |

*Notes*: (*) 1%, (**) 5% and (***) 10% level of significance. The significance level is based on $t$-statistics.

## *5.4 Finance-Growth Nexus*

Table 8 summarizes the statistics relevant to India's finance-growth nexus. As far as the causality of finance→output is concerned, the EG-VECM reveals that although the weak exogeneity result (i.e., ECT coefficient) is estimated as insignificant ($p = 0.244$), both the short-run causality (ΔFDs) and strong exogeneity (ΔFDs & ECT) are detected as significant at the 5% level or better, respectively. Meanwhile, the stronger evidence of output→finance is discovered, as all three test results are statistically significant in both the FD-VECM and FD-ARDL. Thus, the VECM results indicate a bilateral causality between finance and output, whereas the ARDL results reveal a unilateral causality of output→finance. Carefully taking into account these estimates, in particular the VECM findings, we conclude that India's finance-growth nexus is bilateral while more inclining toward output→finance. Furthermore, different from other empirical studies addressing India's finance-growth nexus (e.g., Bhattacharya and Sivasubramanian, 2003; Singh, 2008), both financial crisis (FC) and financial repression (FR) are mattered in our analysis. Hence, we consider that these two may well have some background effects on output and finance. More precisely, the negative causations of crisis→output and repression→finance might have some impacts on India's finance-growth nexus.

Table 8 - *Finance-Growth Nexus*

| **Panel A:** Finance→output | | | |
|---|---|---|---|
| Model | Causality test | Regressor(s) | Result |
| EG-VECM | Short-run | ΔFD(-1) to (-3) | CHSQ(3) = 11.486*(+) |
| | Weak | ECT(-1) | CHSQ(1) = 1.376 |
| | Strong | ΔFDs & ECT(-1) | CHSQ(4) = 11.965**(+) |
| **Panel B:** Output→finance | | | |
| Model | Causality test | Regressor(s) | Result |
| FD-VECM | Short-run | ΔEG(-1) to (-3) | CHSQ(3) = 22.040*(+) |
| | Weak | ECT(-1) | CHSQ(1) = 15.516* |
| | Strong | ΔEGs & ECT(-1) | CHSQ(4) = 38.809*(+) |
| FD-ARDL | Short-run | ΔEG(0) to (-3) | CHSQ(4) = 33.415*(+) |
| | Weak | ECT(-1) | CHSQ(1) = 3.206*** |
| | Strong | ΔEGs & ECT(-1) | CHSQ(5) = 42.158*(+) |

*Notes*: (*) 1%, (**) 5% and (***) 10% level of significance. The causal direction of either (+) or (–) is based on the sign of the $\beta$ coefficient (see Table 7) and is given to significant short-run and strong exogeneity results.

## *5.6 Financial Repression*

Table 9 reports the impacts of financial repression on output and finance. As mentioned above, the financial repression indicator (FR) is treated as an exogenous $I(1)$ variable in the Johansen cointegration test and VECM assessment. Checking the sign of FR's $\beta$ coefficient in the cointegrating space (see Table 7), we find out such causal directions as positive repression→output and negative repression→finance. According to the statistics in Table 9, the short-run dynamics of ΔFRs→EG in the EG-VECM and ΔFRs→FD in the FD-ARDL are significant at each level. More importantly, all the strong exogeneity results are found as statistically significant; these findings imply that FR is a variable necessary to maintain the overall causality in each model. Here, we highlight that financial repression had a positive impact on economic growth in India over the investigated period. Although deviating from the McKinnon-Shaw hypothesis, this result is more likely in India. Under heavy government controls, directed credit programs continued to share a large portion of the total domestic credit, and public sector enterprises were the main players in India's economic development as well as the dominant receivers of funds produced by financial repression over a long time period.

TABLE 9 - *Financial Repression*

| Repression→output/finance | | | |
|---|---|---|---|
| Model | Causality test | Regressor(s) | Result |
| EG-VECM | Short-run | ΔFR(-1) to (-3) | CHSQ(3) = 6.525***(+) |
| | Strong | ΔFRs & ECT(-1) | CHSQ(4) = 8.495***(+) |
| FD-VECM | Short-run | ΔFR(-1) to (-3) | CHSQ(3) = 6.072 |
| | Strong | ΔFRs & ECT(-1) | CHSQ(4) = 25.263*(-) |
| FD-ARDL | Short-run | ΔFR(0) to (-1) | CHSQ(2) = 15.656*(-) |
| | Strong | ΔFRs & ECT(-1) | CHSQ(3) = 17.895*(-) |

*Notes*: (*) 1% and (***) 10% level of significance. The causal direction of either (+) or (–) is based on the sign of the $\beta$ coefficient (see Table 7) and is given to significant short-run and strong exogeneity results.

### *5.7 Finance-Growth-Crisis Nexus*

Panel A of Table 10 documents the effects of financial crisis either on output or on finance, and shows that the strong exogeneity result of ΔFCs & ECT is statistically significant at the 1% level in the FD-VECM. Looking at the sign of FC's $\beta$ coefficient in the cointegrating space (see Table 7), we confirm that financial crisis has a positive impact on financial development. Moreover, the short-run dynamics of ΔFCs are insignificant in all the models. On the other hand, Panel B of Table 10 reports how financial crisis is caused by output, finance and repression, respectively. The findings are summarized as: all the weak exogeneity results are significant; except ΔEGs & ECT, all the strong exogeneity results are significant; and no significant short-run dynamics are detected. Thus, we observe that India's financial crisis is associated with more long-run causes.

TABLE 10 - *Finance-Growth-Crisis Nexus*

**Panel A:** Crisis→output/finance

| Model | Causality test | Regressor(s) | Result |
|---|---|---|---|
| EG-VECM | Short-run | ΔFC(-1) to (-3) | CHSQ (3) = 5.417 |
| | Strong | ΔFCs & ECT(-1) | CHSQ (4) = 6.035 |
| FD-VECM | Short-run | ΔFC(-1) to (-3) | CHSQ (3) = 2.495 |
| | Strong | ΔFCs & ECT(-1) | CHSQ (4) = 21.376*(+) |
| FD-ARDL | Short-run | ΔFC(0) to (-1) | CHSQ (2) = 1.117 |
| | Strong | ΔFCs & ECT(-1) | CHSQ (3) = 3.444 |

**Panel B:** Output/finance/repression→crisis

| Model | Causality test | Regressor(s) | Result |
|---|---|---|---|
| FC-VECM | Short-run | ΔEG(-1) to (-3) | CHSQ(3) = 0.099 |
| | Short-run | ΔFD(-1) to (-3) | CHSQ(3) = 2.074 |
| | Short-run | ΔFR(-1) to (-3) | CHSQ(3) = 1.016 |
| | Weak | ECT(-1) | CHSQ(1) = 12.628* |
| | Strong | ΔEGs & ECT(-1) | CHSQ(4) = 3.427 |
| | Strong | ΔFDs & ECT(-1) | CHSQ(4) = 17.185*(+) |
| | Strong | ΔFRs & ECT(-1) | CHSQ(4) = 14.838*(+) |
| FC-ARDL | Short-run | ΔEG(0) | CHSQ(1) = 1.496 |
| | Short-run | ΔFD(0) to (-3) | CHSQ(4) = 2.148 |
| | Short-run | ΔFR(0) | CHSQ(1) = 0.235 |
| | Weak | ECT(-1) | CHSQ(1) = 13.457* |
| | Strong | ΔEGs & ECT(-1) | CHSQ(2) = 14.326*(-) |
| | Strong | ΔFDs & ECT(-1) | CHSQ(5) = 18.828*(+) |
| | Strong | ΔFRs & ECT(-1) | CHSQ(2) = 14.439*(+) |

*Notes*: (*) 1% level of significance. The causal direction of either (+) or (–) is based on the sign of the $\beta$ coefficient (see Table 7) and is given to significant short-run and strong exogeneity results.

From the significant findings, we pick up a positive bilateral causality of finance↔crisis. This causal link might be relevant to a financial boom – in the form of macroeconomic volatility – that can increase the volume of money supply or credit provided by deposit banks and/or the stock market activities in an unusual manner. Reversely, we also point out the feedback in which an increase in banking/stock market activities can further enhance a financial boom. Such a two-way mechanism might have typically worked before India's 1991 crisis. Furthermore, as given by the strong exogeneity results of $\Delta$FRs & ECT significant at the 1% level in both FC-VECM and FC-ARDL, financial repression can raise the risk of financial crisis. Although different from a standard monetary theory, we argue that extremely high levels of nominal interest rate and reserve requirements in a boom period can attract more speculative funds – rather than contain a credit boom – further increasing the volatility in emerging economies where financial markets have been progressively liberalized but not properly supervised. In particular, the increasing interest rate gap between high-rate emerging economies and low-rate developed economies might become prominent contributing to the uncertainty in the former. In fact, when India's financial repression reached its peak in the late 1980s [see Appendix 1(d)], the country was in a credit boom and a serious financial crisis came soon a few years later.

## 6. Conclusion and policy implication

This paper examines India's 'finance-growth-crisis nexus' by conducting the cointegration and Granger causality analysis through the techniques of VECM and ARDL. The key findings are: (1) India's finance-growth nexus is bilateral but exhibits stronger evidence of output→finance; and (2) output, finance and repression have significant long-run impacts on the occurrence of financial crisis. We argue that it is plausible to implement the 'finance-growth-crisis' analysis. That is, for seeking more accurate estimates of the finance-growth nexus, especially in emerging economies like India, financial crisis should be taken into estimation. And the conventional view in the literature – the origins of India's 1991 crisis were traced back to macroeconomic imbalances created during the late 1980s – has been empirically confirmed through our analysis. Finally, exploring a new dimension of India's finance-growth-crisis nexus, we present the following policy implication. According to the

McKinnon-Shaw hypothesis and the endogenous growth theory, financial intermediation can enhance economic growth mainly through mobilizing savings and allocating those funds efficiently to productive investment projects. In terms of this argument, India's financial system seems to be less efficient in improving informational asymmetries, reducing transaction costs and allocating resources to the real sector. Meanwhile, deeper finance and higher extent of financial repression can lead to financial crisis. Hence, our policy implication is that a well-regulated financial development and well-designed financial policies are vital to achieve crisis-free economic growth while maximizing the positive effect of finance→output.

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## ABSTRACT

This paper attempts to explore a new dimension of India's 'finance-growth-crisis' nexus. For this end, the summary indicators of financial development, financial crisis and financial repression are created through the principal component approach, and we perform the cointegration and Granger causality analysis employing the methods of vector error correction model (VECM) and autoregressive distributed lag (ARDL). The element of structural break is also taken into assessment while specifying the break date through the Bai and Perron (1998; 2003) test. The key findings are: (1) India's finance-growth nexus is bilateral but exhibits stronger evidence on the causality of output→finance; and (2) economic growth, financial development and financial repression have significant long-run impacts on financial crisis.



Keywords: Finance-growth Nexus; Financial Crisis; Cointegration; Causality; India

JEL Classification: E44; O11; O16; O53



## RIASSUNTO

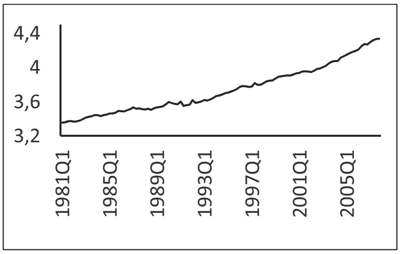
*L'interazione finanza-crescita-crisi in India: evidenze da una analisi di cointegrazione e causalità*

Scopo di questo lavoro è l'analisi di un nuovo aspetto della relazione finanza-crescita-crisi in India. A questo fine vengono elaborati indicatori sintetici di sviluppo della finanza, di crisi e di repressione finanziaria attraverso l'analisi delle componenti principali e viene eseguita un'analisi di cointegrazione e di Granger-causalità utilizzando i metodi del modello *vector error correction* (VECM) e dell'*autoregressive distributed lag* (ARDL). Viene valutato anche il *break* strutturale specificandone la data con il test di Bai e Perron. Le principali evidenze ottenute sono: (1) la relazione finanza-crescita in India è bilaterale ma mostra maggiore evidenza la relazione di causalità dalla crescita alla finanza; (2) la crescita economica, lo sviluppo finanziario e la repressione finanziaria hanno effetti di lungo periodo sulle crisi finanziarie.

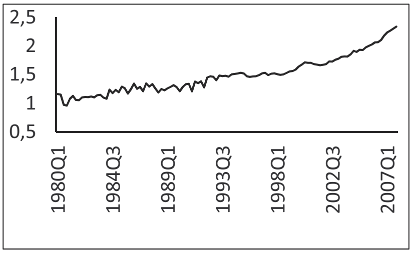
# APPENDIXES

## APPENDIX 1 - *India's EG (Real per Capita GDP) and Summary Indicators*

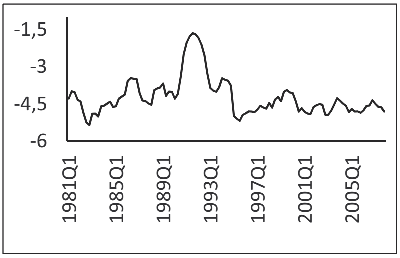
*(a) EG*



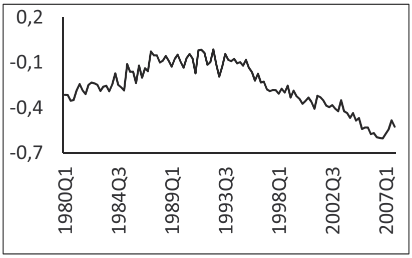

*(b) FD*




*(c) FC*




*(d) FR*



## APPENDIX 2 - *List of Elementary Variables of Financial Development*

| Definition (Name) | Sources |
|---|---|
| Money supply/GDP (MTG) | Line 35L (for money supply) and 99B (for GDP) |
| Deposit money bank assets/GDP (BATG) | All categories of line 22 (for deposit money bank assets) and line 99B |
| Private credit by deposit money banks/ GDP (PCTG) | Line 32D (for private credit) and 99B |
| Stock market capitalization/GDP (SKTG) | FSD |
| Stock market total value/GDP (SVTG) | FSD |

*Notes*: all the "lines" refer to those of the International Financial Statistics (IFS). Annual series of SKTG and SVTG are disaggregated to quarterly ones by the Boot *et al*. (1967) method. FSD = Financial Structure Dataset.

## APPENDIX 3 - *List of Elementary Variables of Financial Crisis*

### *(a) Core Variables*

| Definition (Name) | Sources |
|---|---|
| Exchange rate (ER) | ER = NER * (USCPI/ICPI) where NER is nominal exchange rate (line RF), and USCPI and ICPI are US and India's consumer price indexes, respectively |
| M. supply/foreign exchange reserve (MTF) | MTF = NM/(FR * NER) where NM is nominal money supply (line 35L) and FR is foreign exchange reserve (line 1D) |

### *(b) External Variables*

| Definition (Name) | Sources |
|---|---|
| External debt (ED) § | ED = (NED * NER)/CPI where NED is nominal external debt (WDI) |
| Trade volume (TV) | TV = [(X + I) * NER]/CPI where X + I is the sum of exports and imports (lines 70 and 71) |
| Oil price (OP) | OP = (NOP * NER)/CPI where NOP is nominal oil price (line 76AA) |

*(c) Fiscal, Shock, Real Sector and Money Sector Variables*

| Definition (Name) | Sources |
|---|---|
| Fiscal deficit (FCD) § | FCD = NFCD/CPI where NFCD is nominal fiscal deficit (Reserve Bank of India) |
| Share price (SP) | SP = NS/CPI where NSP is nominal share price (line 62) |
| Inflation rate (IR) | IR = [(CPI – CPI(-1))/CPI(-1)] * 100 |
| Real interest rate (RR) | RR = NR – IR where NR is nominal interest rate (discount rate) (line 60) |
| GDP (GDP) § | GDP = NGDP/CPI where NGDP is nominal GDP (line 98B) |
| Money supply (MS) | MS = NM/CPI |

*(d) Banking and Stock Market Variables*

| Definition (Name) | Sources |
|---|---|
| Total domestic deposit (TD) | TD = NTD/CPI where NTD is the sum of demand- and time deposits (lines 24 and 25) |
| Deposit money bank assets (BA) | BA = NBA/CPI where NBA is nominal bank assets (all categories of line 22). |
| Private credit by deposit money banks (PC) | PC = NPC/CPI where NPC is nominal private credit (line 32D) |
| S. market capitalization/ GDP (SKTGV) § | FSD |
| S. market total value/ GDP (SVTGV) § | FSD |

*Notes*: all the "lines" refer to those of the International Financial Statistics (IFS). § indicates that annual series are disaggregated to quarterly ones by the Boot *et al.* (1967) method except GDP that is by the Chow and Lin (1971) method. WDI = World Development Indicators. FSD = Financial Structure Dataset. As the result of the principal component analysis, FC is made from 12 elementary variables of ER, MTF, ED, TV, OP, FCD, SP, IR, GDP, MS, TD and SKTGV.

## APPENDIX 4 - *List of Elementary Variables of Financial Repression*

| Definition (Name) | Sources |
|---|---|
| Nominal interest rate (NR) | Line 60 (for bank rate) |
| Com. bank reserve/m. supply (CRTM) | Lines 20 (for CB reserves) and 35L (form. supply) |
| Com. bank reserve/GDP (CRTG) | Lines 20 and 99B (for GDP) |
| Com. bank reserve/total deposit (CRTD) | Lines 20 and 24 and 25 (for total deposit) |
| Claims on the gov./m. supply (GTM) | Lines 32AN (for claim on the government) and 35L |
| Claims on the gov./GDP (GTG) | Lines 32AN and 99B |
| Claims on the gov./total domestic credit (GTD) | Lines 32AN and 32 (for total domestic credit) |
| Inflation tax (Seigniorage) (IT) | Change in reserve money (line 14)/ GDP (line 99B) |

*Notes*: all the “lines” refer to those of the International Financial Statistics (IFS).