IS FINANCIAL DEEPENING RELATED TO ECONOMIC GROWTH? EMPIRICAL EVIDENCE FROM INDIA

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ABSTRACT

The purpose of this paper is to conduct empirical research to find out is "financial deepening" effect economic growth in India ? Unlike many earlier research, focus of this Paper is on the "causal relationship between financial deepening and economic growth" in order to distinguish between numerous alternative theoretical ideas. The improved "Granger Causality Test" Method established by "Toda and Yamamoto (1995)" is used in this Paper. Variables such as "private sector credit, wide money, credit deposit ratio, and bank deposit liabilities" are used to describe "financial deepening". The findings largely support the concept that "financial deepening" is a key determinant of "economic growth", despite the fact that economic growth determines "financial deepening". The results do not differ much across the proxies considered for financial depth. The causal links are also demonstrated to be primarily long-term in character. As a result, to be able to develop "financial deepening" in India, government policies targeted at supporting economic growth must be consistent and long-term.

Key Words: Financial Deepening, Economic growth, Toda and Yamamoto causality test, Perron 97unit root test.

SECTION 1

INTRODUCTION

Traditionally, "financial depth" is seen as a crucial precondition for facilitating a country's process of high and sustainable economic development and progress. Well-functioning "financial institutions" can improve economic efficiency by creating and expanding liquidity, mobilizing savings, increasing capital accumulation, transferring resources from "traditional (non-growth) sectors" to modern "growth-inducing" sectors, which will encourage competent entrepreneur response in these sectors.

In most of the developing countries, in the absence of strong non-banking institutions and stock markets, banks are very important "financial intermediaries to play a key role in transforming deposits into financial assets". They transfer cash from firms with "excess liquidity to those with insufficient liquidity", boosting capital formation and promoting trade. Banks also play a crucial function in information filtering by screening borrowers and monitoring their behavior in financial systems with Incomplete and asymmetric information. Their increased efficiency is thus critical to the achievement of financial deregulation (Ephraim & Montfort, 2004). In this context, "well-developed financial systems can be expected to accelerate the development process" by channeling financial recourses to the most productive use. Bank-based "financial

system" encourages long-term finance which is dedicated to long-term productive investment that reduces speculative activities. The most influential works supporting this "hypothesis are perhaps Levine and King 1993a, 1993b, which suggest that better 'financial systems' lead to more robust economic growth". Bank-based financial system may help implement expansionary monetary and industrial policy, given the "relationship between financial and industrial firms" (Arestis and Demetriades, 1996). Therefore Financial Deepening[1] in this paper focus on banks vis- a- vis Economic Growth.

Throughout the modern history of economics, the "relationship between financial development and economic expansion" has attracted a considerable deal of attention. Its origins can be "traced back to Lydia in Asia Minor", where the first money was found. However, the first evidence of public debate on the "relationship between money and growth, as well as experimentation with free banking", can be found in Rome in 33 AD. In that year there was probably the first classic case of public panic and run on the banks. The Romans debated intensely and fiercely at that time the prospect of placing a hitherto free banking system under the "control of the government". Since then, of course, a great number of economists have dealt with the issue. An early and intellectual development came from Bagehot (1873), in his classic *Lombard Street*, where he emphasised the critical importance of the "banking system in economic growth" and highlighted circumstances when "banks could actively spur innovation and future growth by identifying and funding" productive investments. At this juncture the research of Schumpeter (1912) should also be mentioned. He argued that "financial services are paramount in promoting economic growth". This claim was attested by many other studies like Gurley and Shaw (1955), Patrick (1966), Goldsmith (1969) and Mckinnon (1973) and Shaw (1973). More recently, "endogenous growth research has suggested that financial intermediation raises steady-state growth while government interference in the financial sector" lowers equilibrium growth rate (Pagano, 1993, for a survey). Levine and King, 1993b. Levine and Zervos's (1996) research and other later studies argue that "financial systems" respond to the growth of the real sector in an economy. "Financial development propels economic growth" in less developed countries, according to Jung (1986); Levine, Loayza, and Beck (1999). [Arestis and Demetriades (1997), Rosseau and Watchel (1998), Levine and Zervos (1998), Levine et al, (2000), Bell and Rosseau (2001)] all diverge in views regarding the causal patterns and the "endogeneity of model" variables. This divergence seems to emanate from the different estimation procedures and data employed for analysis. Most importantly, results seem to be more greatly and fundamentally determined by the choice of "financial deepening" variables. Against this backdrop, and due to the fact that the India completed almost two decades with economic liberalization, the policy relevance of this paper is established beyond doubt.

Till date; several studies have been undertaken in the area of "financial deepening and economic growth" using cross section, panel and time series data. A few examples may be cited thus, {Luintel and Khan (1999), Demetriades and Hussein (1996), Rubini and Sala-i-Martin (1992), and Jung (1986), Guryay et al (2007) for North Cyprus, Agung and Ford (1998), Murinde and Eng (1994)} for Singapore.

[1] Although "financial deepening is a broader concept" than that of "banking development", the "two concepts are used interchangeably" in this paper.

This paper endeavours to make a meaningful contribution to this debate and improves on previous studies by investigating empirically the "causal relationship between Financial Deepening and Economic Growth" in India during the period 1970-2010 by using the well established "Toda and Yamamoto (1995)" Non-Causality Test Procedure, econometric technique.

The use of the superior "Toda and Yamamoto causality test" constitutes the first point of distinction between this Paper and the existing studies. Most of the "Indian studies like Luintel and Khan (1999), Bhattacharya, P. and Sivasubramanian, M. (2003), Debashis Acharya, S Amanulla, Sara Joy (2009)", have used a single measure of "financial deepening" only; rather than taking into consideration other financial deepening factors. The focus of this work is to close these gaps. This paper's explicit goal is to determine whether, in the sense suggested by "Toda and Yamamoto (1995)", the proxy for "financial deepening influences the direction of causality between the growth of India's financial sector and economic growth".

This paper is divided in 7 sections. First one is introduction. The theoretical framework is reviewed in Section 2, the empirical literature is reviewed in Section 3, the data and its sources are described in Section 4, the "research procedures are briefly" described in Section 5, the empirical results are discussed in Section 6, and the policy implications are concluded in Section 7.

SECTION 2.
THEORETICAL FRAMEWORK

Theoretically, in the "environment friendly, appropriate technology based, decentralized 'Alternative Development Model', finance is not a factor of crucial importance" in economic development. In the "conventional model of modern industrialism however the perceptions in this regard" vary a great deal, (Bhole, 1999). The theoretical literature and cross-sectional conclusion on the subject can be loosely grouped into four main categories; Supply Leading Approach, a Demand Following Approach, independence "between financial development" and "economic growth" Approach and a Cautionary or Feedback Approach.

The 'Supply-Leading' theory proposes a "one-way causal relationship that goes from financial deepening to economic growth", meaning that new functional financial markets and institutions would boost the supply of financial services. This will undoubtedly result in rapid but steady real economic development. This notion serves two purposes: it transfers resources from low-growth sectors to high-growth sectors and it promotes entrepreneurial activity in the latter. According to Hicks (1969), history demonstrates that the 18th-century industrial revolution in England was driven by financial reforms rather than new scientific innovations. Many renowned economists have supported this concept, including {McKinnon (1973), Shaw (1973), Fry (1978), Diaz-Alejandro (1985), and Moore (1986). Calderon and Liu (2002), King and Levine (1993a, b,) and Levine, Beck, and Loayza (2000), Shandre M. Thangevelu, and Ang Bang James Jiunn (2004)} are some recent research that support this idea.

The 'Demand-Following' hypothesis "proposes a one-way causal relationship between economic expansion and financial development". This means that the "financial system has a passive reaction" to economic growth, implying that "rising demand for financial services" may lead to aggressive financial

system expansion as the “real sector of the economy” expands. Robinson (1952), Gurley and Shaw (1955, 1967), Goldsmith (1969), and Jung (1986) are among the studies that support this idea.

Interestingly, another set of well-known economists believes that “financial deepening” is virtually entirely irrelevant to economic growth”. Modigliani and Miller (1958) argued that the way firms finance themselves is irrelevant (their `irrelevance propositions'), which is “consistent with the perception of ‘financial markets’ as independent entities” meaning to that finance and growth are unrelated to the rest of the economy. In his foundational assessment of significant literature in development economics, Stern (1989) completely ignored the relevance of "financial development" in the economic growth process. In defining the” dynamics of economic development”, Nobel Laureate Robert Lucas (1988) stated that “economists have often inflated the importance of ‘financial markets’ in economic development” and that these “markets play only a minor influence in the economic growth” process. If true, the Stern-Lucas hypothesis rules out any “credible causal relationship between ‘financial deepening’ and real economic development”. As a result, a third view appears, “indicating that the two variables are causally” independent.

Aside from the three unique causal hypotheses discussed above, a “fourth and final” statement can be deduced, which is a mixture of the “Supply-Leading and Demand-Following” Hypotheses, referred to as the Feedback Approach. Both hypotheses are “jointly valid” in this case, implying that “financial deepening and real economic development” are mutually causal (there is a bidirectional causality)”. This form of causation pattern appears to be more likely in the long run {(e.g.Greenwood and Smith (1997), Al-Yousif (2002), and many others}.

It should be highlighted that numerous prior research has found a “substantial and positive association between ‘financial deepening’ and ‘real growth’, which does not necessarily support the Supply-Leading hypothesis”. In fact, it is a priori consistent with all of the other “alternative hypotheses” explored in this study. If the “causal relationship between financial depth and real economic growth in a given country obeys hypothesis (2), (3), or (4)”, then most past research in this field may be called into question. In particular, if “causality behaves in accordance with the demand following” hypothesis (2), previous empirical studies that regress “real economic growth” as a "dependent" variable on “financial deepening” as a "independent" variable lose meaning because the “significant coefficient they report should have been assigned to real economic growth rather than financial deepening”. If, on the other hand, the “two variables are ‘causally unrelated’, as hypothesis (3) maintains”, then past empirical findings tying “financial deepening” to real economic development are false, and the stated association is due to some missing variables. “Granger (1980) presents a clear theoretical account of how two variables can be ‘highly correlated’ while remaining causally independent”. Finally, if the “Bi-directional hypothesis (4)” is valid, earlier “results from single-equation models lack credibility” since they are biased and statistically inconsistent due to simultaneous-equation bias. Clearly, then, research on the “role of financial deepening in the economic growth process” should focus not on the correlation but on testing the direction of causality between the two variables.

SECTION 3.

EMPIRICAL EVIDENCE

The subject of causality between "financial development and economic growth" has been examined both theoretically and experimentally in the literature. The “recent focus, however, has been on empirical analysis” where research has been equivocal in its conclusions regarding the hypothesis that “financial development ‘leads’ economic growth”. For example, King and Levine (1993) concluded that “financial development leads economic growth” and Levine and Zervos (1998) “found that ‘stock market’ and ‘banking development’ leads economic growth”. In contrast, Arestis and Demetriades (1997), Shan and Morris (2002) and Shan, Sun and Morris (2001) found that the hypothesis was supported in few of the countries out of many surveyed and, therefore, no general conclusions could be drawn.

The relationship between “economic growth and financial development” is extensively studied with mixed and inconclusive results. The positive view of the finance-led growth hypothesis normally focuses on the “role played by financial development” in mobilizing domestic savings and investment through a more open and more liberalized financial system and in promoting productivity via creating an efficient financial market {(Schumpeter,1912), Patrick (1966)}. The literature by Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Roubini and Sala-I-Martin (1992), Pagano (1993), King and Levine (1993b), Berthelemy and Varoudakis (1996), Greenwood and Smith (1997) support the view that “financial development (repression) has positive (negative) effects on economic growth” in the steady state. Of the above, the studies by Roubini and Sala-I-Martin (1992), King and Levine (1993), Fry (1997), Levine and Zervos (1998) widely use “cross-sectional” techniques to support the hypothesis that “financial sector development is growth enhancing and consequently financial repression” policies are harmful for economic growth. Robinson (1962) for example, has suggested, in an original position, that “financial development follows economic growth”. Newlyn (1977) considers the role of “finance in development” as of subsidiary in nature. Likewise, Lucas (1988) concludes that the “importance of financial markets” is badly overstressed. A similar conclusion is shared by Chandavarkar (1992) who considers that “finance” is never been listed by the pioneers of “development economics” as a key development factor. Some of the recent studies are reviewed in the following paragraphs.

Rudra Prakash Pradhan (2009) investigated the “causal relationship between financial development and economic growth” in India using a multivariate VAR model. Cointegration and the causality test are used in the empirical analysis. The cointegration test determines whether or not “financial development and economic growth” have a long-run equilibrium relationship. The “Granger causality test” reveals bidirectional correlation between the money supply and economic growth, bank credit and economic growth, money supply and foreign trade, and market capitalization and foreign trade.

Ozturk (2008) has reviewed the literature about “finance-growth nexus and investigated the causality between financial development and economic growth” in Turkey from 1975 to 2004 in a “vector auto regression (VAR) framework "based on the “theory of cointegration and error correction representation” of cointegrated variables. The findings suggest that there is a "long-run bidirectional relationship" between “financial development and economic growth”.

Güryay et al. (2007) used the "Granger causality test" to investigate the "relationship between financial development and economic growth" in Northern Cyprus. Although there is evidence of connection between "economic growth and the development of financial intermediaries", the findings imply that "financial development does not drive economic growth".

Mohammed and Sidiropoulos (2006) have "investigated the effect of financial development on economic performance in Sudan" from 1970 to 2004 using the "autoregressive distributed lag (ARDL) model" to co- integration analysis by Pesaran and Shin (1999). Their empirical findings show a "weak relationship between financial development and economic growth. Results owe to "banks' inefficient resource allocation, the 'lack of an appropriate investment climate' required to foster 'significant private investment' in order to promote long-run growth, and the poor quality of bank credit allocation".

Wadud (2005) investigates India, Pakistan and Bangladesh for a "long-run relationship between financial development and economic growth". He classified the financial system as "bank-based or capital-market-based." A cointegrated vector autoregressive model was used in the study to analyze the long-run link between financial development and economic growth. According to the results of the "error correction model", financial development led to economic expansion.

Azege (2004) study analyzed data on aggregate deposit money bank credit over time as well as GDP to demonstrate a marginally positive relationship between" financial deepening and economic growth". He concludes that the "development of financial intermediaries in Nigeria" is crucial to overall economic growth.

Hondroyiannis et al. (2004) investigate the relationship between the development of Greece's banking system and stock market and economic performance from 1986 to 1999 . The empirical results of the "VAR model show that there is long-run bi-directional causality" between finance and growth. Odiambho (2004) explores the significance of "financial development" in South African economic growth and reached at a conclusion that there is a "demand-following connection between financial development and economic growth".

Chen (2002), for example, applied the "cointegration test and the Bayesian vector auto regressions (BVAR) model" to explore the causal link between interest rates, savings, and income in the Chinese economy from 1952 to 1999. He argues that "it is therefore important to establish well-developed financial institutions, in particular the independence of the Central Bank-interest rate liberalization and sound financial intermediation, all of which are important for the efficient allocation of capital, which, in turn, can help to establish sustainable economic growth" (Chen, 2002, p.59).

In the cases of other developing economies, Ansari (2002), who has used a "vector error correction model (VECM)" to analyze the impact of financial development, money and public spending on Malaysian national income, argues that the Malaysian experience has shown "an unambiguous support for the supply-leading view of financial development, implying the importance of financial sector development" (Ansari, 2002, p.72).

Earlier Causality pattern based studies – including that of "Sims (1972), Gupta (1984), Jung (1986), Toda and Phillips (1993), Murende and Eng (1994), Demetriades and Hussein (1996), Arestis and

Demetriades (1996) and Kul and Khan (1999)" – have found that the causality pattern varies across countries.

SECTION 4.

DATA SOURCES AND VARIABLES:

The necessary secondary data[2] for India (in Indian Rupees) for the period 1970-2010 has been "sourced from Reserve Bank of India" and the IMF Annual Financial Statistics.

On the basis available literature; "economic growth is proxied by per capita GDP (YPC), while proxies for financial development used are the ratio of Bank Credit to Private Sector to GDP (BCP), the ratio of Broad Money to GDP (M2Y), the ratio of Bank Deposit Liabilities to GDP (BD), the Credit Deposit Ratio (CD) and the Financial Deepening Index" (FDI).

SECTION 5.

RESEARCH TECHNIQUES:

Traditionally, the "standard Granger (1969) test has been known to be employed in the relevant literature; to test for the causal relationship" between two variables. This test states that, if past values of a variable Y significantly contribute to forecast the value of another variable Xt+1 then Y is said to Granger Cause X and vice versa. The "test is based" on the following regressions:

$$Y_t = \beta_0 + \sum_{k=1}^{M} \beta_k Y_{t-k} + \sum_{l=1}^{N} \alpha_l X_{t-l} + u_t \quad \ldots\ldots (1)$$

$$X_t = \gamma_0 + \sum_{k=1}^{M} \gamma_k X_{t-k} + \sum_{l=1}^{N} \delta_l Y_{t-l} + v_t \quad \ldots\ldots (2)$$

where Y_t and X_t are the "variables to be tested, and u_t and v_t are 'mutually uncorrelated' white noise errors and t denotes the time period" and *'k'* an *'l'* are number of lags.

The "null hypothesis" is $\alpha_l = \delta_l = 0$ for all l's versus the "alternative hypothesis" that $\alpha_l \neq 0$ and $\delta_l \neq 0$ for at least some l's. If the "coefficient α_l's are statistically significant" but δ_l's are not, then "X causes Y" and vice versa. If both α_l and δ_l are significant "then causality runs" both ways.

According to Granger (1986), the test is valid if the "variables are not cointegrated". Recent advancements "in time series analysis have resulted in various enhancements to the standard Granger test". These findings indicate that the "original variables be checked for stationarity before testing for cointegration" between them. Also the "choice of lag duration" is essential for Granger causality.

SECTION 5.1.

UNIT ROOT TEST AND COINTEGRATION:

Unit Root Test was used as part of the "research approach" to check for the "order of integration utilizing time series econometric" methodologies. There are many Unit Root Tests, each with their own set of pros and limitations; however, in the current work, the Augmented Dicky Fuller (ADF), Philip-Perron (PP), and Perron 97 Unit Root tests were used.

[2] Per Capita GDP is converted into log. Credit –Deposit Ratio belongs to Scheduled Commercial Banks.

Unit Root "tests are used essentially to verify the stationarity properties (absence of trend and long-run mean reversion) of the time series data" so as to avoid spurious regressions. A series is said to be "stationary if the mean and autocovariances of the series" are not dependent on time. A series is said to be "integrated of order d", denoted by I(d), if it has to be differenced d times before it becomes stationary. Consider the equation:

$$\gamma_t = \rho\gamma_{t-1} + \chi_t \delta + \varepsilon_t \quad \ldots\ldots (3)$$

Where χ_t are optional exogenous regressors which; may consist of constant, or a constant and trend, ρ and δ are "parameters" to be estimated and ε_t is assumed to be white noise.

If $|\rho| \geq 1$, γ is a nonstationary series and the variance of γ increases with time and approaches infinity if $|\rho| < 1$, γ is a (trend) stationary series. Thus, the hypothesis of (trend) stationarity can be evaluated by testing whether the absolute value of ρ is strictly less than one.

ADF test using MacKinnon (MacKinnon, 1991) critical values, constructs a parametric correction for higher-order correlation by assuming that the y series follows an AR (p) process and adding p lagged difference terms of the "dependent variable" y to the right-hand side of the test regression.

$$\Delta\gamma_t = \alpha\gamma_{t-1} + \chi_t\delta + \beta_1\Delta\gamma_{t-1} + \beta_2\Delta\gamma_{t-2} + \ldots + \beta_2\Delta\gamma_{t-2} + \nu_t \quad \ldots\ldots (4)$$

This augmented specification is then used to test the hypothesis:

$H_0: \alpha = 0$, against $H_1: \alpha < 0$

If the "null hypothesis" $H_0: \alpha = 0$ is not rejected, then it implies that $\alpha = 0$ and the series α contains a unit root. Where $\alpha = \rho - 1$ and evaluated using the conventional t-ratio for α

$$t_\alpha = \hat{\alpha} / (se(\hat{\alpha}))$$

Where $\hat{\alpha}$ is the estimate of α and *se* $(\hat{\alpha})$is the coefficient standard error.

Phillips (1987) and Phillips-Perron (1988) have proposed an alternative strategy for detecting the presence of unit roots in data, in which a nonparametric test to the usual t-test was developed, which is resistant to a wide range of serial correlation and time dependent hetroscedasticity. The following equation (without trend) must be estimated for the PP unit root test.

$$X_t = \mu_t + \sum_{i=1}^{T} X_{i-T} + u_t \quad \ldots\ldots (5)$$

However, both the above mentioned tests cannot capture "structural changes in the time series" data; which is a very natural situation in today's economy. Economic crises, policy changes, changes in institutional arrangements, and regime transformations can all cause structural changes in many time series. The subject of structural changes has become increasingly important in the "analysis of macroeconomic time series" in recent years. Testing the "null hypothesis of structural stability against the alternative of a one-time

structural break" is one of the issues linked with structural change. If such structural changes occur during the data generation process but are not accounted for in the specification of an econometric model, the findings may be biased towards the incorrect non-rejection of the non-stationarity hypothesis. Perron (1989, 1997); Leybourne and Newbold (2003). Perron and Vogelsang (1992) and Perron (1997) proposed a class of test statistics that allow for two types of structural break: the Additive Outlier (AO) model, allowing for structural changes to occur instantly, and the Innovational Outlier (IO) model, which assumes changes to occur gradually. In this paper, the Innovational Outlier (IO) model was applied.

The Perron 97, IO model allows for a "gradual change in the intercept (IO1) and gradual changes in both the intercept and the slope of the trend" function (IO2) such that:

$$\textbf{IO1: } x_t = \mu + \phi DU_t + \beta_t + \delta D(T_b)_t + \alpha x_{t-1} + \sum_{i=1}^{k} c_t \Delta x_{t-1} + \varepsilon_t \quad \ldots\ldots (6)$$

$$\textbf{IO2: } x\,t = \mu + \phi DU_t + \beta_t + \gamma DT_t + \delta D(T_b)_t + \alpha x_{t-1} + \sum_{i=1}^{k} c_t \Delta x_{t-1} + \varepsilon_t \quad \ldots\ldots (7)$$

where T_b denotes the time of break ($1 < T_b < T$) which is unknown, 1 *t DU* = if $t > T_b$ and zero otherwise, $DT_t = T_t$ if $t > T_b$ and zero elsewhere, D (T_b) = 1 if $t = T_b + 1$ and zero otherwise, x_t is any general "ARMA process and e_t is the residual term assumed white noise".

The "null hypothesis of a unit root is rejected" if the absolute value of the t-statistic for testing α=l is "greater than the corresponding" critical value.

Perron (1997) suggests that the "time of structural break (T_b) can be determined by two approaches. In the "first approach, equations (1) or (2) are sequentially estimated" assuming different T_b with T_b chosen to minimize the t-ratio for α =1. In the "second approach, T_b is chosen amongst all other possible break point values" to minimize the t-ratio on the estimated slope coefficient (γ).

The data-dependent method proposed by "Perron (1997) is used to calculate the truncation lag parameter (k)". In this method, the "value of k" is determined by whether the t-ratio on the coefficient associated with the last lag in the calculated autoregression is significant. Up to a maximum order k, the optimum k (or k*) is chosen so that the coefficient on the final lag in an autoregression of order k* is significant and the last coefficient in an autoregression of order more than k* is unimportant (Perron, 1997). The least restrictive model is tried first, and then others follow.

To determine "whether there exists a long run relationship between financial development and economic growth", methodologies such as the multivariate Johansen approach (Johansen 1988, 1992) and (Johansen and Juselius, 1990) cointegration procedure in line with Kar and Pentecost (2000) have been applied. The Johansen approach utilizes two statistic tests namely: the trace test and the maximal eigenvalue test.

First, the "Likelihood Ratio (LR) test" based on the "trace statistics (λ trace)" which tests the H_0: $r \leq q$ against the H_1: q = r is calculated thus:

$$\lambda_{trace}(r) = -T \sum_{i=1+1}^{p} \ln(1 - \hat{\lambda}_t) \quad \ldots\ldots (8)$$

Where $\lambda r+1,\ldots.\lambda n$ are the least value eigenvectors (p-r).

Subsequently, the Maximal Eigenvalue Test (λ_{max}) which tests the H0: there are r-cointegrating vectors against H1: there are r+1 cointegrating vectors; is calculated thus:

$$\lambda_{max}(r,r+1))=-T\ln(1-\hat{\lambda}_r+1) \quad \ldots\ldots (9)$$

If a long run cointegrating relationship exit between variables, then causality between them is tested by the error correlation model. However, if the "null hypothesis of non-stationarity is rejected" and the variables are not cointegrated; then the "standard Granger causality" test is appropriate.

SECTION 5.2.

GRANGER CAUSALITY IN TODA AND YAMAMOTO VERSION:

The standard "Granger (1969) causality test for inferring 'leads and lags' among integrated variables" has been shown to produce false regression results, and the F-test is ineffective unless the "variables in levels" are cointegrated.

New developments in econometric techniques offer the "**Error Correction Model** (due to Engle and Granger (1987)) and the **Vector Auto Regression Error-Correction Model** (due to Johansen and Jesulius, 1990)" as alternatives for the testing of "non-causality" between economic time series. Unfortunately, these tests are "cumbersome and sensitive" to the values of the "nuisance parameters in finite samples" and therefore their results have been found to be unreliable (see "Toda and Yamamoto, 1995; Zapata and Rambaldi", 1997).

Toda and Yamamoto (1995) "proposed a simple procedure requiring the estimation of an 'augmented' VAR, even when there is cointegration", which "guarantees the asymptotic distribution of the MWald statistic". Therefore, the "Toda-Yamamoto causality" procedure is considered as the "long-run causality test". All that requires to be done to "determine the maximal order of integration d_{max}, which is expected to occur in the model and construct a VAR in their levels" with a total of $(k + d_{max})$ lags. Toda and Yamamoto "point out that, for d=1, the lag selection procedure is always valid, at least asymptotically", since k > =1=d. If d=2, then the "procedure is valid unless k=1". Moreover, according to "Toda and Yamamoto, the MWald statistic is valid regardless whether a series is I (0), I(1) or I (2), non-cointegrated or cointegrated of an arbitrary order".

To illustrate the principle, a" bivariate model", with one lag (k=1), may be considered, that is:

$$x_t = A_0 + A_1 x_{t-1} + e_t \quad \ldots\ldots (10)$$

Or more fully

$$\begin{bmatrix} x_{1t} \\ x_{2t} \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} \alpha_{11}^{(1)} & \alpha_{12}^{(1)} \\ \alpha_{21}^{(1)} & \alpha_{22}^{(1)} \end{bmatrix} \begin{bmatrix} x_{1,t-1} \\ x_{2,t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \quad \ldots\ldots (11)$$

where

$$E(e_t) = E\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} = 0$$

And

$$E(e_t e_t') = \Sigma$$

To test "that x_2 does not Granger cause x_1, the parameter restriction $\alpha_{12}^{(1)} = 0$ requires to be" tested. If it is assumed that x_{1t} and x_{2t} are I(1), a standard t-test may not be valid. Following "Dolado and Lutkepohl (1996), test (1) $\alpha_{12}^{(1)} = 0$ requires to be tested constructing the usual Wald test" based on "least squares estimates in the augmented model":

$$\begin{bmatrix} x_{1t} \\ x_{2t} \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} \alpha_{11}^{(1)} & \alpha_{12}^{(1)} \\ \alpha_{21}^{(1)} & \alpha_{22}^{(1)} \end{bmatrix} \begin{bmatrix} x_{1,t-1} \\ x_{2,t-1} \end{bmatrix} + \begin{bmatrix} \alpha_{11}^{(2)} & \alpha_{12}^{(2)} \\ \alpha_{21}^{(2)} & \alpha_{22}^{(2)} \end{bmatrix} \begin{bmatrix} x_{1,t-2} \\ x_{2,t-2} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \quad \ldots\ldots (12)$$

The "Wald statistic will be asymptotically distributed as a Chi Square, with degrees of freedom equal to the number of 'zero restrictions' irrespective of whether x_{1t} and x_{2t} are I (0), I (1) or I (2), non-cointegrated or cointegrated" of an arbitrary order.

Employing the "seemingly unrelated regression (SURE) framework", a VAR (5) may be estimated as follows:

$$\begin{bmatrix} p_t \\ q_t \\ r_t \\ s_t \\ t_t \end{bmatrix} = \beta_0 + \beta_1 \begin{bmatrix} p_t - 1 \\ q_t - 1 \\ r_t - 1 \\ s_t - 1 \\ t_t - 1 \end{bmatrix} + \beta_2 \begin{bmatrix} p_t - 2 \\ q_t - 2 \\ r_t - 2 \\ s_t - 2 \\ t_t - 2 \end{bmatrix} + \beta_3 \begin{bmatrix} p_t - 3 \\ q_t - 3 \\ r_t - 3 \\ s_t - 3 \\ t_t - 3 \end{bmatrix} + \beta_4 \begin{bmatrix} p_t - 4 \\ q_t - 4 \\ r_t - 4 \\ s_t - 4 \\ t_t - 4 \end{bmatrix} + \begin{bmatrix} p_t - 5 \\ q_t - 5 \\ r_t - 5 \\ s_t - 5 \\ t_t - 5 \end{bmatrix} + \begin{bmatrix} ep_t \\ eq_t \\ er_t \\ es_t \\ et_t \end{bmatrix} \quad \ldots\ldots (13)$$

Variables entering the model: Real Per Capita Income (YPC), Broad Money relative to GDP (M2Y), Bank Credit to the Private Sector relative to GDP (BCP), Bank Deposit Liabilities (BD) and Credit Deposit Ratio (CD) are denoted as p, q, r, s and t respectively.

SECTION 5.3.

PRINCIPLE COMPONENT ANALYSIS:

"Principal Component Analysis (PCA)" is used to construct financial development index. The technique is supposed to simplifying a data set by reducing multidimensional data sets to lower dimensions for analysis. Technically, "PCA is an Orthogonal Linear Transformation that transforms the data to a new coordinate system so that the greatest variance by any projection of the data comes to lie on the first coordinate (called the first principal component), the second greatest variance on the second coordinate", and so on.

PCA can be "used for dimensionality reduction in a data set while retaining those characteristics of the data set that contribute most to its variance, by keeping lower-order principal components and ignoring

higher-order ones". Such low-order "components often contain the most important aspects" of the data. The methodology of "Principal Component Analysis" has been discussed in detail by Theil (1971)[3].

SECTION 6.

EMPIRICAL RESULTS:

As the first step order of integration for all the five variables is determined using ADF, PP and Perron 97 test:

Table 1

UNIT ROOT TEST ON LEVELS

Variables	With a constant		With a constant and Trend		Perron 97 IO2 Model		
	ADF	PP	ADF	PP	T_b and k	T_α	Result
YPC	3.822	4.734	-1.125	-1.016	1993:4	-2.3429	I(1)
BCP	1.715	1.104	0.414	-0.218	2000:2	-2.7289	I(1)
M2Y	0.95	0.557	-0.975	-1.482	1993:3	-4.0104	I(1)
BD	3.843	3.167	1.516	1.302	2004:3	-3.1565	I(1)
CD	3.603	2.905	1.515	0.959	1995:3	-4.3406	I(1)
Critical Values at 5%	-2.964	-2.961	-3.544	-3.544		-5.55	

Table 1 show that all the "chosen variables have a unit root at levels" but they are tested and found "stationary" at first difference[4]. **The Perron 97** test is done to capture "structural break in the time series" under test. Results of Perron 97 have shown that all chosen series had a break after liberalization in India suggesting towards some impact of liberalization process adopted in 1991. Knowing the type of integration in the series, a "long run relationship between economic growth and financial development" variable was first established using the Johansen multivariate cointegration approach by Johansen (1988, 1992); and Johansen and Juselius (1990).

Tables 2A and 2B tabulate the results of the Johansen multivariate cointegration test as below.

Table 2A

UNRESTRICTED COINTEGRATION RANK TEST (TRACE TEST)

Null	Alternative	Trace Statistic	5% Critical Value
r = 0	r = 1	107.6915	70.4900
r<= 1	r = 2	64.1005	48.8800
r<= 2	r = 3	28.9395	31.5400

[3] Theil (1971)

[4] Results are not "presented due to paucity of space" but are available from researcher on demand.

Table 2B

UNRESTRICTED COINTEGRATION RANK TEST (MAXIMAL EIGENVALUE TEST)

Null	Alternative	Trace Statistic	5% Critical Value
r = 0	r = 1	43.5910	33.6400
R<= 1	r = 2	35.1610	27.4200
R<= 2	r = 3	20.5077	21.1200

The trace and maximal eigenvalue test result in table 2A & 2B above suggests "two cointegrating equation" at the 0.05 level of significance thus "confirms the rejection of the null hypothesis" of no cointegrating vectors among the chosen variables.

The above results are based on the "assumptions of the existence" of linear deterministic trend and lag interval in first difference of 1 to 1. Overall, the "Johansen cointegration test" suggests that there is a sustainable cum long-run equilibrium relationship between "economic growth proxied by real per capita income (YPC) and financial deepening variables proxied by BCP, M2Y, BD and CD".

Table 3 tabulates the "causality test results" obtained from Toda-Yamamoto test based on SUR estimation[5].

Table 3

TODA-YAMAMOTO TEST BASED ON SUR ESTIMATION

NULL HYPOTHESIS	MWALD STATISTIC	P-Value	Result
BCP does not Granger cause YPC	.41130	[.521]	*Cannot Reject* H_0
YPC does not Granger cause BCP	6.0428*	[.014]	*Reject* H_0
M2Y does not Granger cause YPC	1.2121	[.271]	*Cannot Reject* H_0
YPC does not Granger cause M2Y	16.6891*	[.000]	*Reject* H_0
BD does not Granger cause YPC	.51576	[.473]	*Cannot Reject* H_0
YPC does not Granger cause BD	3.2499*	[.071]	*Reject* H_0
CD does not Granger cause YPC	.26884	[.604]	*Reject* H_0
YPC does not Granger cause CD	.85994	[.354]	*Reject* H_0
GROWTH-VS- FINANCIAL DEEPENING			
FDI does not Granger cause YPC	.83604	[.361]	*Cannot Reject* H_0
YPC does not Granger cause FDI	6.2301*	[.013]	*Reject* H_0

In the Toda-Yamamoto sense, the causality test suggests that growth proxied by real per capita income (YPC) causes bank - based financial deepening (BP) without a feedback. Also, growth causes financial

[5] One lag was chosen by AIC and SBC for the model and maximum order of integration is one. So the model is worked with two lags.

deepening (M2Y) and (BD) without a feedback. Growth (YPC) and credit deposit ratio turned out to be independent. These outcomes suggest growth led "bank-based" finance. This empirical result validates Waqabaca (2004) and Kar and Pentecost (2000) but fails to validate Levine et al (1999) and Jung (1986).

To have a much clear picture of growth and bank based financial deepening, all the variables used for financial deepening have been converted into an **Index of Financial Deepening (FDI)** using PCA. The results obtained from Toda Yamamoto test done to "determine causality between FDI and Growth", as per Table 3, suggest "Growth led financial deepening" in India during the period of 1970-2010 and not the other way round thus assisting many, who supported the demand following hypothesis.

SECTION 7.

CONCLUSION AND POLICY IMPLICATIONS:

Given the brevity of the annual sample period, in addition to the well-known caveats associated with the Granger concept of causality, the conclusions drawn in this paper are only suggestive and should thus be interpreted cautiously.

However, the empirical results suggest that all the chosen series for variables used had a structural break after the adoption of liberalization process; thereby implying a strong possibility of the liberalization process having an "impact on financial deepening and economic growth" in India.

The financial deepening (in terms of banking sector) and economic growth were found to be positively co-integrated indicating a "stable and long-run equilibrium relationship between financial deepening and economic growth" in India.

The findings also exhibited that for four (i.e. bank private sector credit and broad money, bank deposit ratio and financial deepening index) out of the five variables used for proxing financial deepening, there is a "unidirectional causality between bank- based financial deepening and economic growth" implying thereby, that "economic growth leads to financial deepening" in India supporting the famous "Demand Following" Approach.

However, for the fifth variable, i.e. Credit Deposit Ratio, proxied for bank based financial deepening, there is independence between; bank based "financial deepening and economic growth", thus supporting the Independence Approach.

Therefore, the results of this study were found to be mixed and an important conclusion drawn is that the choice of variables proxied for financial deepening may influence and impact the direction of Causality with economic growth in India.

As the majority of the "results obtained confirm that Economic Growth leads to financial deepening", the focus of the economic policies adopted by the policy makers should be on growth enhancing policies, however this should not be done at the cost of policies related with bank based financial deepening.

SECTION 8.

Limitation and scope for further research

Despite the fact that this paper may have been the only one to use a time series for 40 years, an "important limitation" for this paper may be the number and choice of variables used as proxy for financial deepening.

The above result also defines the further scope for research, which should be to confirm the result obtained here under through application of a wider and bigger set of variables as proxy to the financial deepening in India.

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