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Measuring financial development in India: A PCA approach

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Abstract. *Financial development is a multidimensional concept and its measurement is thorny for the researchers. A good measurement of financial development is decisive in evaluating the progress of financial sector development and understanding the corresponding impact on economic growth and poverty reduction. The study makes use of the PCA (Principal components analysis) to construct a financial depth index (IFD) that serves as a proxy variable of financial development position of the country. This paper used Indian time series data covering a period from 1980 to 2011(Index-1) and 1990-2011(Index-2) for measurement of two separate financial development index. This study gives insight for understanding various financial sector proxies as well as to enhance the knowledge of financial position of the country. The proposed index is easy to compute and comparable across countries.*

Keywords: Financial development, IFD, PCA, multidimensional, thorny, decisive.

JEL Classification: E44, G2, O1.

1. Introduction

In general, financial development is broadly defined as an increase in the volume of financial services of banks and other financial intermediaries as well as of financial transaction of capital markets (Hussain and Chakraborty, 2012). Financial sector in earlier times were considered to play only a minor role in the process of economic growth. But with the development of sophisticated financial system in every nation across the globe, modern economists conclude that the development of the financial sector of an economy can be an important aid towards the economic growth. A growing body of evidence suggests that the financial institutions (such as banks and insurance companies) and financial markets (including stock markets, bond markets, and derivative markets) exert a powerful influence on economic development, poverty alleviation, and economic stability [Levine (2005)]. Since the financial sector of a country comprises a variety of financial institutions, markets and products, these measures only serve as a rough estimate and do not fully capture all aspects of financial development.

1.1. Financial development in Indian context

Indian economy had experienced major policy changes in early 1990s. The new economic reform, the popularly known as, Liberalization, Privatization and Globalization (LPG model) aimed India a fast growing and globally competitive economy. With the onset of reforms to liberalize the Indian economy in July of 1991, a new chapter has dawned for India and her billion plus population. This period of economic transition had a tremendous impact on the overall economic substantiate with numbers. Besides, it also marks the advent of the real integration of the Indian economy into the global economy. Now that India is in the process of restructuring her economy, with aspirations of elevating herself from her present desolate position in the world, the need to speed up her economic development is even more imperative. And having witnessed the positive role that FDI has played in the rapid economic growth of most of the Southeast Asian countries and most notably China, India has embarked on an ambitious plan to emulate the successes of her neighbors to the east and is trying to sell herself as a safe and profitable destination for FDI.

1.2. Benefit of financial globalization in India

The real benefits of financial globalization to an emerging market economy have less to do with the raw financing provided by foreign capital. Instead, the indirect "collateral" benefits associated with such capital are far more important. These indirect benefits may be crucial for India's development. One of the key benefits is that openness to foreign capital catalyzes financial market development. Foreign investment in the financial sector tends to enhance competition, raise efficiency, improve corporate governance standards and stimulate the development of new financial products. For instance, in India, even the limited entry of foreign banks has already given domestic banks a much-needed kick in the rear side and forced them to improve their efficiency in order to compete and stay viable. Liberalizing outflows has the salutary effect of giving domestic investors an opportunity to diversify their portfolios internationally. This means greater competition for domestic financial institutions but also an opportunity for them to cultivate the financial savvy to offer products that would help their customers invest abroad. Other

indirect benefits associated with foreign capital include transfers of expertise technological and managerial from more advanced economies. When supported by liberal trade policies, foreign investment can help boost export growth. Foreign invested firms also tend to have spillover effects in generating efficiency gains among domestic firms.

2. Literature review

The relationship between financial development and economic growth can be traced back to the work of Schumpeter (1911, 1939) emphasized that financial intermediaries play an important role in promoting economic growth by redirecting funds towards innovative projects. Voluminous literature, both theoretical and empirical, has come up on this issue over the years. The theoretical contributions have highlighted the different services provided by the financial sector that can affect output and growth (Dimond 1984; Bencivenga and Smith 1991; Saint-Paul 1992). Levine (1993) could be one of the earliest one in which they find a statistically significant positive relationship between the measures of financial development and growth while analyzing 77 countries for the period 1960-1989. Following the work by King and Levine (ibid.), many studies offered econometric evidence that supports the view that financial development is a potent predictor of future economic growth. Many studies [see Hussain and Chakraborty (2012), Jalil and Feridun (2011), McKinnon (1973), Goldsmith (1969)] have also made significant progress in establishing that to some extent, the casual relationship runs from financial development to economic growth. Chakraborty (2010) examined the impact of the developments in the financial sector on economic growth in India in the postreform period. The model of Mankiw et al. (1992) was extended to establish a relationship between financial development and economic growth. The model was then estimated using quarterly data for the period 1993 to 2005 for India, using the techniques of co integration and vector error correction method. The findings lend no support to the theoretical prediction that the stock market development would play an important role in enhancing economic growth in India. On the contrary, reforms measures on the market rate of interest that were introduced in the Indian banking system appear to have promoted economic growth significantly. Akinlo and Egbetunde (2010) examined the long run and casual relationship between financial development and economic growth for ten countries in sub-Saharan Africa (Central African Republic, Chad, Congo Republic, Gabon, Kenya, Nigeria, Sierra Leone, South Africa, Swaziland and Zambia) for the period 1980-2005. The result shows that there is a long run relationship between financial development and economic growth in the selected ten countries in sub-Saharan Africa. Again it shows that financial development Granger causes economic growth in Central African Republic, Congo Republic, Gabon and Nigeria while economic growth Granger causes financial development in Zambia. Inoubli (2011) examined how financial development impacted growth in the MENA (Egypt, Jordan, Moroco, Tunisia and Turkey) region during 1981 to 2008. The author used many proxies for financial development in this study and found all affect the economic growth by considering the threshold effect. Bojanic (2012) focused on the relationship of economic growth with financial development and trade openness in Bolivia. The study covers annual time series data for Bolivia during the 1940-2010. The results show that there is a long run

equilibrium relationship between economic growth, financial development and trade openness indicators and unidirectional relationship between financial development and trade openness indicators to economic growth. The study by Masoud and Hardaker (2012) provided a theoretical frame work that integrates the endogenous growth functions of financial market and institutions theory in order to investigate how the financial market and banking sector develop indicators that affect economic growth in cross countries. The study covers financial development and economic growth for 42 emerging markets over 12 years using endogenous growth model. The results suggest that stock market development has a significant effect on economic growth and there is a stable long term equilibrium relationship between the evolutions of the economy. Guevara and Maudos (2012) analyzed the effect of European financial integration on economic growth. This study focused on how the international financial crisis that started in 2007 affected integration and growth. The result illustrate that a significant part (42%) of financial development is attributable to progress in integration, accounting for 1.9% of the Euro area's GDP growth over the period 1999 to 2000. Gounder (2012) examined whether financial development promotes economic growth in Fiji over the period 1970 to 2005. The methods applied are co integration and the error correction model to test the long run equilibrium and short run relationship among the key variables relevant for this study. Here cointegration test results support the existence of a long run relationship. And, the short term dynamic behavior of the relationship between financial development and growth show that financial development has made a modest contribution to output. The study by Sahoo (2013), empirically evaluates the role of financial structures in economic development of India. The study makes use of data for the period 1982-83 through 2011-12. The study considered 1982-83 as the starting period due to non-availability of data on stock market capitalization prior to this period. The study finds oneway Granger causality from bank-based financial depth to economic development supporting the premise that growth is more of supply-driven. However, there is no evidence of causality between market capitalization and economic development. A detailed analysis based on co integration method revealed that both the bank based and market based indicators of financial depth have positive impact on economic development in India. The above theories (Schumpeter 1939, 1991) and various empirical studies (Diamond and Dybvig 1983; Smith 1991) suggest that the financial intermediaries play an important role in promoting economic growth. There is a positive and bidirectional long run relationship between financial development and economic growth. From the above abundant literature says different authors used different financial proxies (e.g. Broader money (M2) to nominal GDP, private sector credit to GDP, liquid liabilities of the financial sector to GDP, commercial bank assets to total banking sector assets, and stock market capitalization to GDP) for measuring financial depth.

3. Limitation of earlier studies

A well defined and a structured research problem is the heart of every research. The main drawback of the earlier studies is found in the way researchers have used different type of financial proxy variables for measuring the financial death position of the country. Most of the researcher was widely used stock market capitalization, M2 and private sector credit to

GDP in their studies to measured financial development position of the countries, which is not an efficient measure to capture complete financial depth of the country. And till now, no such specific method is found which can evaluate the financial depth position. In this paper I propose the use of Principal Component Analysis [Chakraborty (2010), Hussain and Chakraborty (2012), Gounder (2012), Adu.*et.al.* (2013)] to compute a single index based on various financial indicators for measuring financial depth for India.

4. Methods of study

This section tells about the methodology part of this paper. Firstly, we describes about Principal component analysis. Secondly, description of variable used in PCA for constructed in the financial development Index 1 & 2.

4.1. About PCA

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to (i.e., uncorrelated with) the preceding components. Principal components are guaranteed to be independent if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables. (See Wikipedia). Since there is no single aggregate index, this paper constructs an index of financial development which measures the overall development in the financial sector.

The study uses principal component method to combine the eleventh selected measures of financial development in to single index. According to this procedure the jth factor Fj can be expressed as:

$$Fj = WJ_1X_1 + WJ_2X_2 + WJ_3X_3 + \ldots.. + WJ_PX_P \quad (1)$$

Where:
Fj = estimate of jth factor
Wj = weight on factor score coefficient
P = number of variables

4.2. Description of variables and its data sources

In this section discusses various financial depth variable used in both financial development index-1&2.

a) Private sector credit to GDP (PSC): It is a primary indicator of financial sector development. This is equal to the value of credits by financial intermediaries to the private sector divided by GDP. This measure includes all the credit issued to the private sector by all the financial institutions in addition to the traditional depository money banks. This measure isolates credit issued to the private sector as opposed to

credit issued to governments and public enterprises and concentrates on credit issued by intermediaries other than the central bank. PSC basically gives the degree of financial intermediation and measures the financial resources provided to the private sector through for example, loans, purchases of non-equity securities, and trade credits. Here, it collected from International Financial Statistics (IFS), International Monetary Fund (IMF).

b) ***Total assets held by deposit money banks as a share of GDP (BA):*** It is another indicator of financial development. Here, assets include claims on domestic real nonfinancial sector which includes central, state and local governments, nonfinancial public enterprises and private sector. Deposit money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits. This Variable collected from International Financial Statistics (IFS), International Monetary Fund (IMF).

c) ***Central bank assets to GDP (CBA):*** This is another proxy variable for indication of financial development in the country. It includes ratio of central bank assets to GDP. Central bank assets are claims on domestic real nonfinancial sector by the Central Bank. This data collected from International Financial Statistics (IFS), International Monetary Fund (IMF).

d) ***Liquid liabilities of the financial sector to GDP:*** It denoted as LL, is another traditional measure of financial sector development. LL is the liquid liabilities of the financial system and is currency plus demand and interest-bearing liabilities of financial intermediaries and non-bank financial intermediaries as a percentage of GDP. This is the broadest available indicator of financial intermediation, since it includes all three financial sectors (central bank, commercial bank and other financial institutions). It is a typical measure of financial "depth" and thus of the overall size of the financial sector without distinguishing between the financial sectors or between the use of liabilities. It indicates the degree of monetization with respect to the real economy. This variable data was collected from International Financial Statistics (IFS), International Monetary Fund (IMF).

e) ***M2 (ratio to monetary GDP):*** It is used as one of the proxy measure of financial depth in developing countries. The money supply (M2) that includes M1, plus savings and small time deposits, overnight repos at commercial banks, and non-institutional money market accounts. It is a key economic indicator used to forecast inflation. Theoretically, an increase in this ratio shows an increase in financial depth. However, in developing countries M2 contains large portion of currency. The implication of rising M2 is monetization instead of financial depth (Demetriades and Hussein 1996). This variable was collected from World Bank's WDI database.

f) ***Financial system deposits to GDP (FSD):*** This is another indicator for financial depth of the country. It includes Demand, time and saving deposits in deposit money banks and other financial institutions as a share of GDP. It was collected from International Financial Statistics (IFS), International Monetary Fund (IMF).

g) ***Credit to government and state owned enterprises to GDP (CGSE):*** It was denoted by CGSE. It includes ratio between credit by domestic money banks to the government and state-owned enterprises and GDP. This data also collected from International Financial Statistics (IFS), International Monetary Fund (IMF).

h) Remittance inflows to GDP (RI): It is another source for financial development. A remittance is a transfer of money by a foreign worker to an individual in his or her home country. Money sent home by migrants competes with international aid as some of the largest financial inflows to developing countries like India. Here, Workers' remittances and compensation of employees comprise current transfers by migrant workers and wages and salaries earned by nonresident workers. Data are the sum of three items defined in the fifth edition of the IMF's Balance of Payments Manual: workers' remittances, compensation of employees, and migrants' transfers. It collected from World Banks' World Development Indicators (WDI) database.

i) Total reserves to GDP (TR): Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. This is one of the indicators for financial stability of country. Primary data are in current USD form. Then we converted it as percentage of GDP. It was collected from World Banks' World Development Indicators (WDI) database.

j) Net inflows of foreign direct investment as a share of GDP (IFDI): Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP. This was one of the main indicators of financial depth of country. It was collected from World Banks' World Development Indicators (WDI) database.

k) Gross domestic savings as a share of GDP (GDS): Gross domestic savings are calculated as GDP less final consumption expenditure (total consumption). It was used as old indicator for financial depth of country. Data of GDS are collected from World Banks' World Development Indicators (WDI) database.

l) Outstanding domestic private debt securities to GDP (PDS): Total amount of domestic private debt securities (amount outstanding) issued in domestic markets as a share of GDP. It covers data on long-term bonds and notes, commercial paper and other short-term notes. This PDS used as proxy for financial depth of country. Data of PDS are collected from Bank for International Settlements (BIS).

m) Outstanding domestic public debt securities to GDP (PUDS): Total amount of domestic public debt securities (amount outstanding) issued in domestic markets as a share of GDP. It covers long-term bonds and notes, treasury bills, commercial paper and other short-term notes. It was another indicator for financial development. Here data are collected from Bank for International Settlements (BIS).

n) The stock market capitalization to GDP ratio, denoted by SMC, which equals the value of listed shares divided by GDP. Market capitalization (also known as market value) is the share price times the number of shares outstanding. Listed domestic companies are the domestically incorporated companies listed on the country's stock exchanges at the end of the year. Listed companies does not include investment

companies, mutual funds, or other collective investment vehicles. Data are collected from Global Stock Markets Factbook and supplemental S&P data, Standard & Poor's.

o) ***Stock market total value traded to GDP (ST):*** Stocks traded refers to the total value of shares traded during the period. This indicator complements the market capitalization ratio by showing whether market size is matched by trading. Now it was used as a new prominent proxy for financial depth. Here, data are collected from Global Stock Markets Factbook and supplemental S&P data, Standard & Poor's.

5. Results and discussion

This section presents and discusses the empirical results of this analysis. The empirical result of the paper follows the following sequential steps. Firstly, we used principal components analysis to reduce the eleven dimensions of the financial indicators in to a single index. This is much relevance since none of the eleven indicators can solely serve as an adequate proxy for financial development. By using the PCA, we are able to extract much of information in all the indicators, while at the same time avoiding the potential multicolinearity problem of including more than one proxy in a given equation. Secondly, we used total fifteen variables including four more financial markets variables to construct financial development Index-2. Lastly, discuss the graphical representation of analysis. It's give insight the relationship between financial index and real GDP per capita (proxy for growth). And the different reaction of both financial index-1&2, where in index-2 includes 4 more financial market variables.

The Eigen values in table 1 indicate that the first principal component explains more than 90% of the standardized variance. Hence, the first principal component is a more relevant measure of financial development, as it explains the variations of the dependent variable better that any other linear combination of explanatory variables. Therefore, only information related to the first principal component is considered to form a composite indicator. For each year in the analysis here, the factor score (see table 2) are obtained by the corresponding factor score coefficients using equation 1. Thus a composite financial development indicator (FD index-1) is obtained.

Table 1. *PCA for Index-1 (1980-2011)*

Principal component	Eigen values	Variance (%)	Cumulative (%)
1	9.938	90.350	90.350
2	0.460	4.178	94.528
3	0.266	2.415	96.942
4	0.186	1.687	98.629
5	0.099	0.902	99.531
6	0.033	0.304	99.836
7	0.011	0.096	99.931
8	0.005	0.045	99.976
9	0.002	0.020	99.996
10	0.000	0.003	99.999
11	0.000	0.001	100.000

Extraction method: principal component analysis.

Table 2. *Components score coefficient matrix (1980-2011)*

Variables	Component 1
PSC	0.093
BA	0.099
CBA	-0.092
LL	0.100
M2	0.100
FSD	0.099
CGSE	0.094
RI	0.094
TR	0.098
IFDI	0.092
GDS	0.091

Extraction method: principal component analysis.

Similarly Index-2 in formed using other more financial market variables like stock market capitalization, total stock traded outstanding private debt securities as well as outstanding public debt securities from 1991 to 2011.

Table 3. *PCA for Index-2 (1990-2011)*

Principal Component	Eigen value	Variance (%)	Cumulative (%)
1	12.603	84.017	84.017
2	1.033	6.885	90.902
3	0.493	3.284	94.186
4	0.433	2.887	97.073
5	0.208	1.388	98.461
6	0.118	0.787	99.248
7	0.051	0.339	99.587
8	0.023	0.152	99.740
9	0.020	0.137	99.876
10	0.011	0.074	99.950
11	0.005	0.030	99.981
12	0.002	0.014	99.995
13	0.001	0.004	99.998
14	0.000	0.001	100.000
15	0.000	0.000	100.000

Extraction method: principal component analysis.

In index-2 first principal components also explains about 84% percent of the standardize variance. Here we consider more than 1 Eigen values with highest variance corresponding components for composite indicator. In both cases we used KMO and Bartlett's Test for sampling adequacy in the analysis, found more than 80 percent. It tells that our data is sufficient for PCA analysis to construct composite index. In table 2 shows the eleven variables with its factor score coefficient for component 1 to construct index-1. Similarly table 3 describes Eigen values and variance for index-2. And Table 4 describes factor score coefficient for 2nd financial depth index.

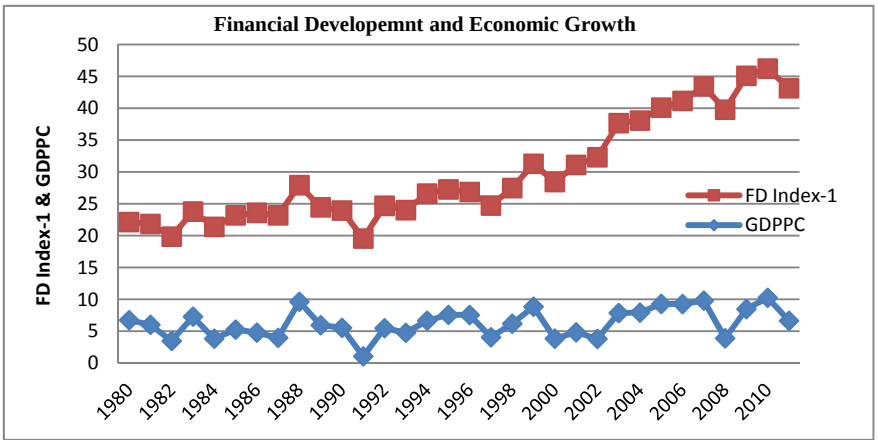
Table 4. *Component score coefficient matrix (1990-2011)*

Variables	Component 1
PSC	0.076
BA	0.078
CBA	-0.073
LL	0.078
M2	0.079
FSD	0.078

Variables	Component 1
CGSE	0.070
RI	0.071
TR	0.076
IFDI	0.070
GDS	0.070
PDS	0.057
PUDS	0.076
SMC	0.069
ST	0.066

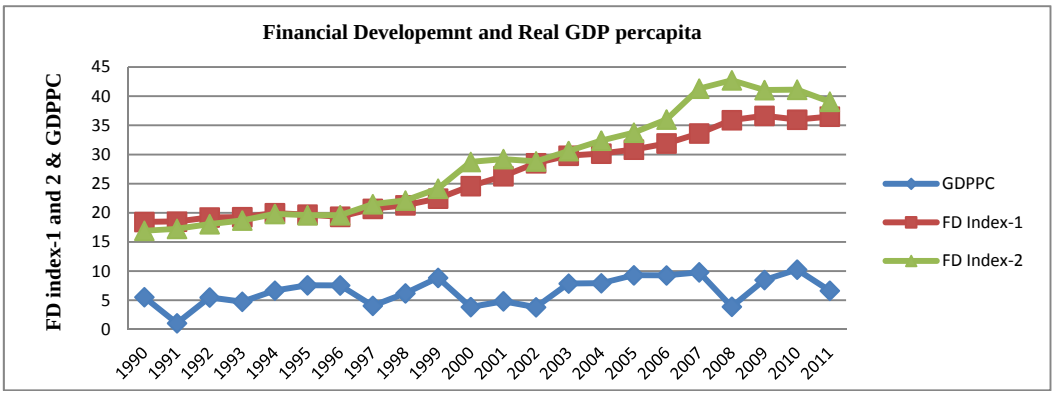
Extraction method: principal component analysis.

Figure 1. *(Financial development and economic growth between 1980 to 2011)*



In the above figure 1 plots the resulting index of FD and economic growth of country India from 1980 to 2011. The index coincides fairly well with the economic state of affairs and policy Changes that happened during the sample period. As is apparent in the index-1, the level of financial development is sharply increased from 1991 onwards due to new economic policy introduced in the country of India. Then it decreases in the year 2000-01 due to U.S. recession. And it increases as increasing rate and reached the top position in the year 2007. After 2007, as expected it was sharply falling during the year 2007-09 due to global financial crises and it was affected the financial position as well as real GDP per capita in the Indian economy. The financial depth of the country even high volatility after this great recession, it shows the instability condition in the economy and downfalls continued now days. Fig no 2 shows the relationship between the real GDP per capita with financial development of the country with two different financial indexes from the year 1990 to 2011. As we know that SEBI (Securities and Exchange Board of India) was officially established in the year 1988 and given statutory powers in 1992 with SEBI Act 1992 being passed by Indian Parliament. And new phase of financial globalization began with improvements in information technology and the removal of barriers to the free flow of capital across counties in the mid of 1980s (Behera and Ranjan, 2009). Then gradually financial markets are coming to picture and played dominant role in the Indian economy. To check the impact of financial markets along with financial institutions in the economy, we used financial markets variables like stock market capitalization, total stock traded,

Figure 2. *(Comparison between two financial index with economic growth): 1990-2011*



Outstanding domestic private debt securities and public debt securities to construct financial index-2. The figure indicate that there is positive and proportional relationship between GDP per capita and financial depth of the country over the sample period. Due to globalization effect in the year 1991 the GDP of the country increase and it resulted the sharp increase in the financial development in the country and vice versa. In the other ways, say economic growth of the country increases due to increase in the financial development in India. And there is little bit difference in both index-1&2; financial index-2 is more volatility nature in comparison to index-1. It was because of high variability in the stock market. Another major difference that in index-1, the external financial shock period (global financial crises) was shown immediately where as its affect occurs after some time in index-2. In the year 2007, due financial crisis the both financial position and GDP per capita in the country sharply declined. After the year 2008, it was gradually starts increases due to increased in the financial development. Then country faced financial instability after 2009 and it was continued till end of sample period. It was caused downfall as well as variability in the real GDP per capita.

6. Conclusion and future direction of the study

The aim and objective of this paper is to measure the financial development of India. The study proposes an Index for Financial development (IFD)-a multidimensional measure developed in the line with well known development indexes such as HDI, GDI, IFI, HPI and GEM. IFD can be used to compare the extent of financial development across different economies and to monitor the progress of the economies with respect to financial development over time. The analysis is based on combinations of various financial institutions as well as financial market variables to construct a single index for capturing country's financial depth. I have constructed two separate indexes for financial depth in case of India during 1980 to 2011.Through principal components analysis method I found that financial development is the sole cause for economic development. Maximum proxy, including both financial goods and services, are used to construct this financial index. Such an index can also use to researchers to address empirical work on the relationship between development and financial depth of country in India. And the same index can be made for other countries by other researchers as well. For the time being, the analysis is confined with annual time series data. In future, I will include new

variables and try to identify the financial position as well as the impact of financial development on economic growth for other countries too.

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