Nexus between Income and Expenditure of Banks in India: A Panel Vector Error Correction Causality Analysis

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Abstract

Empirical research on Indian Bank efficiency has attracted a considerable attention among academics, planners and policy makers. Financial sector plays a very crucial role in the economic growth of a country and the importance of this sector's contribution is more in a developing economy like India. Financial intermediation is essential to the promotion of both extensive and intensive growth. In this context, considering the operating approach, this study attempts to investigate the long-run co integrating and causal relationships between total income and total expenditures of Banks in India by using a panel of 38 Banks from 1992 to 2013.The FMOLS and DOLS are then used to estimate the long run relationship between the variables. In this study, we have estimated Granger causality for income-expenditure relationships by performing a single equation estimator in the form of the FMOLS developed by Pedroni for the estimation of the residuals which have been included in the panel VECM as the error correction terms (ECTs). Following Hsiao and Hsiao (2006), this paper used both FEM and REM to estimate panel data. The Hausman test results indicate that the FEM is appropriate to estimate the panel bivariate vector error correction model (PBVECM). To conclude, in the long run, both total income and total expenditure could play an important adjustment role as the system departs from the long-run equilibrium.

Key words: Bivariate vector error correction model, Financial Market, Granger causality test.

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Introduction

Empirical research on Indian Bank efficiency has attracted a considerable attention among academics, planners and policy makers. Financial sector plays a very crucial role in the economic growth of a country and the importance of this sector's contribution is more in a developing economy like India. Financial intermediation is essential to the promotion of both extensive and intensive growth. Thus, development of the financial system is essential to the generation of higher productivity and economic growth. In view of these changing circumstances in banking sector, the present study considers the operating approach (or income-based approach), taking output as the total revenue (interest and non-interest) and inputs as the total expenses (interest and operating expenses). In this context, this study attempts to investigate the long-run co integrating and causal relationships between total income and total expenditures of banks in India.

Data and Sources.

The data are sourced from various issues of *'Statistical Tables relating to banks in India'*, a yearly publication by RBI. We used a sample of 38 Banks, which include 19 Nationalised Banks, 13 old Private Sector Banks, and 6 SBI and its Associates. for the period 1991-92 to 2012-13[1].. The variables used are Total Income (TI) and Total Expenditure (TE) of the selected Indian Banks. Natural logarithms of those variables are symbolized as LnTI and LnTE.

Panel Unit Root

In this section, we examine the long-run co integrating and causal relationships between the income and expenditure of the Indian Banking sector using recently developed techniques for

[1] Annual data for the period 1991-92 to 2012-13 for 38 Indian banks have been used for the analysis. The criterion for inclusion in the sample is the consistent availability of data on the relevant variables for the period 1991-92 to 2012-13 **(Annexure A-I).** Also see, http://dbie.rbi.org.in/DBIE/dbie.rbi?site=statistics.

dynamic panels. Before proceeding to co integration techniques, we need to verify that all variables are integrated to the same order.The results of panel unit root tests on relevant variables are furnished in Table 1.

It may be seen that the tests[2] fail to reject the null hypothesis of a unit root for each of the variables in level form. The tests, however, reject the null of a unit root in the first difference. Overall, the results reveal that the two variables viz., total income and total expenditure are non-stationary but integrated of order 1, i.e., I (1).

Table 1: Panel Unit Root Test Results for the Variables in Levels and First Differences

Variable : LnTI in levels				
Method	**Statistic**	**Prob.**	**Statistic**	**Prob.**
	Individual effects		**Individual effects, individual linear trends**	
Levin, Lin & Chu t	4.47555	1.0000	-1.58466	0.0565
Breitung t-stat	-	-	-1.59258	0.0556
Im, Pesaran and Shin W-stat	11.8748	1.0000	-0.95809	0.1690
ADF - Fisher Chi-square	9.92425	1.0000	82.0811	0.2965
PP - Fisher Chi-square	8.39164	1.0000	37.6966	0.9999
Variable : LnTE in levels				
Method	**Statistic**	**Prob.**	**Statistic**	**Prob.**
	Individual effects		**Individual effects, individual linear trends**	
Levin, Lin & Chu t	5.4093	1.0000	1.89867	0.9712
Breitung t-stat	-	-	-2.88828	0.0019
Im, Pesaran and Shin W-stat	12.4937	1.0000	1.18725	0.8824

[2] **Common root - Levin, Lin, Chu, Commonroot - Breitung, Individual root - Im, Pesaran, Shin, Individual root - Fisher - ADF, and Individual root –Fisher – PP.**

ADF - Fisher Chi-square	7.4189	1.0000	58.9236	0.9264
PP - Fisher Chi-square	7.37623	1.0000	20.4227	1
Variable : LnTI in first differences(Δ LnTI)				
Method	**Statistic**	**Prob.**	**Statistic**	**Prob.**
	Individual effects		**Individual effects, individual linear trends**	
Levin, Lin & Chu t	-12.6258***	0.0000	-10.4799***	0.0000
Breitung t-stat	-	-	-7.65152***	0.0000
Im, Pesaran and Shin W-stat	-10.888***	0.0000	-7.37491***	0.0000
ADF - Fisher Chi-square	253.319***	0.0000	178.046***	0.0000
PP - Fisher Chi-square	252.638***	0.0000	179.168***	0.0000
Variable : LnTE in first differences(Δ LnTE)				
Method	**Statistic**	**Prob.**	**Statistic**	**Prob.**
	Individual effects		**Individual effects, individual linear trends**	
Levin, Lin & Chu t	-10.9561	0.0000	-10.3151***	0.0000
Breitung t-stat	-	-	-5.77489***	0.0000
Im, Pesaran and Shin W-stat	-8.89696***	0.0000	-5.71972***	0.0000
ADF - Fisher Chi-square	212.582***	0.0000	150.452***	0.0000
PP - Fisher Chi-square	203.431***	0.0000	145.271***	0.0000

Note:The null hypotheses of all unit root tests state that the series include unit root while the alternative hypotheses state the absence of unit root. ***,**, and * indicate stationarity at 1%, 5%, and 10% significance levels, respectively.

Panel Co integration

Since income and expenditures were found to be I (1), in the next step, an attempt has been made to test, whether there exists a long-run equilibrium (steady state) between them through panel cointegration tests. Panel cointegration technique has an advantage over the cointegration tests for individual series as it allows to selectively pool information regarding common long-run relationships from across the panel while allowing the associated short-run dynamics and fixed effects to be heterogeneous across different members of the pane.

We make panel cointegration analysis by applying three panel cointegration tests. These are Pedroni , Kao, and Johansen Fisher panel cointegration tests. Pedroni developed seven different tests to determine the existence of panel cointegration. All of these can be divided and applied as constant and constant and trend tests. Six of these seven Pedroni tests demonstrate cointegration in constant and constant and trend models, respectively.

The results of the Pedroni test are also supported by Kao residual cointegration test, which rejects the null hypothesis of no cointegration at 1 per cent level (Table 3). The results of Johansen Fisher cointegration test are indicated in Table 4. When we take a glance at the results, the null hypothesis stating the nonexistence of cointegrated vector is rejected. Nevertheless, the null hypothesis suggesting the existence of at most 1 cointegrated vector is accepted. Thus, we can conclude that there is cointegration relationship (Table4). The results from tables 2- 4 show that all three methods of cointegration test support the presence of a cointegrated relationship between the two variables at the 1% significant level, respectively. The overall findings of the panel cointegration tests reveal that there is a long run equilibrium relationship among examined variables meaning that income and expenditure are moving together in the long run.

Table 2: Pedroni Residual Cointegration Test

Within-dimension				
	No deterministic trend		Deterministic intercept and trend	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	4.779921***	0.0000	4.553237***	0.0000
Panel rho-Statistic	-3.663375***	0.0001	-1.990404**	0.0233
Panel PP-Statistic	-3.734198***	0.0001	-6.224074***	0.0000
Panel ADF-Statistic	-3.924030***	0.0000	-6.758027***	0.0000

Between-dimension				
	Statistic	Prob.	Statistic	
Group rho-Statistic	-0.889248	0.1869	-0.125962	0.4499
Group PP-Statistic	-2.870640***	0.0020	-7.237443***	0.0000
Group ADF-Statistic	-3.212939***	0.0007	-9.920040***	0.0000

Note: ***, **, and * indicate stationarity at 1%, 5%, and 10% significance levels, respectively.

Table 3: Kao Residual Cointegration Test

Kao Residual Cointegration Test	**t-Statistic**	**Prob.**
ADF	-12.2056***	0.0000
Residual variance	0.003602	
HAC variance	0.002911	

Note: ***, **, and * indicate stationarity at 1%, 5%, and 10% significance levels, respectively.

Table 4: Johansen Fisher Panel Cointegration Test

Hypothesized	**Fisher Stat.***		**Fisher Stat.**	
No. of CE(s)	(from trace test)	Prob.	(from max-eigen test)	Prob.
None	117.8***	0.0015	123.8	0.0004
At most 1	58.04	0.9377	58.04	0.9377

Panel FMOLS and DOLS Models

Given that our variables are cointegrated, the next step is to estimate the long-run equilibrium relationship. Panels FMOLS and DOLS methods are efficient techniques to eliminate these problems[3]. Panel FMOLS is a method eliminating serial correlation effect by applying a nonparametric transformation to residuals which are obtained from cointegration regression. Panel DOLS is a parametric method which is used to obtain long-run coefficients by taking into account the lead and lagged values of variables.. Panels DOLS and FMOLS techniques facilitate establishing a regression without the need to take differences of the cointegrated variables. As the existence of the cointegrating relationship was supported, we estimated the FMOLS and DOLS methods. According to the panel FMOLS and DOLS results, LTE is significant at 1% level. All of the coefficients have positive signs which are compatible with the theory. According to FMOLS results the elasticity coefficients of total expenditure and total income are 1.04 and 0.96, respectively. According to DOLS results the elasticity coefficients of total expenditure and total income are 1.05 and 0.95, respectively (Table 5).

Table 5: Panel FMOLS and DOLS Results for the Banks in India.

Model	Variable	Coefficient	Std. Error	t-Statistic	Prob.
FMOLS: LTI= β_0+ β_1LTE+u	LTE	1.040592***	0.004995	208.3373	0.0000
FMOLS: LTE= β_0+ β_1LTI+u	LTI	0.956113***	0.004603	207.7267	0.0000
DOLS: LTI= β_0+ β_1LTE+u	LTE	1.045768***	0.005421	192.8981	0.0000
DOLS: LTE= β_0+ β_1LTI+u	LTI	0.954006***	0.005002	190.7323	0.0000

Note: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively.

Since the FMOLS and DOLS estimators have similar results in terms of estimated parameters and corresponding p- values, we have performed a single equation estimator in the form of the FMOLS developed by Pedroni (2000) for the estimation of the residuals which will be included in the panel VECM as the error correction terms (ECTs) [4]. The FMOLS estimator has been

[3] The Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) methodologies are proposed by Kao and Chiang (2000) to estimate the long-run cointegration vector, for non-stationary panels. These estimators correct the standard pooled OLS for serial correlation and endogeneity of regressors that are normally present in long-run relationship.

[4] The FMOLS estimator is preferred to the DOLS because in the latter the co-variates are included in first differences and not in levels. Moreover, according to Pedroni (2001) and Breitung and Pesaran (2005), FMOLS and

applied to as many single equations as the number of the variables included in the VECM that are I(1) and cointegrated. For bivariate models, we have therefore estimated ECTs as the residuals (ε it and ηit respectively) from the two following equations:

FMOLS Equation 1: LTI= β_0+ β_1LTE+u ---- (1)
FMOLS Equation2 : LTE= β_0+ β_1LTI+u ----(2)

As can be seen from this Table 5, the coefficients in all three equations are statistically significant at the 1 % level. The residuals obtained from estimating the above regressions (FMOLS) will be included in the panel VECM as the error correction terms (ECTs).

Panel Vector Error Correction Model

In our study, we have estimated Granger causality for income -expenditure relationships by performing a single equation estimator in the form of the FMOLS developed by Pedroni (2000) for the estimation of the residuals which will be included in the panel VECM as the error correction terms (ECTs). The FMOLS estimator has been applied to as many single equations as the number of the variables included in the VECM that are I(1) and cointegrated.

. The next step for building a Granger causality model with a dynamic error correction term based on Holtz-Eakin *et al.* (1988) is to incorporate the residuals from the first step into a panel VECM. The VECM results distinguish between short-run and long-run Granger causality. It also indicates that The coefficients (and the magnitudes) of the ECM indicate the speed of adjustment to the long-run equilibrium relationship. The final dynamic error correction model can be specified as follows

$$\Delta LTI_{i,t} = \alpha_i + \sum_{j=1}^{m} \delta_{i,j} \Delta LTI_{i,t-j} + \sum_{s=1}^{q} \gamma_{i,s} \Delta LTE_{i,t-s} + \lambda_{1i} ECM1_{i,t-1} + u_{i,t} \text{-----(3)}$$

DOLS estimators possess the same asymptotic distribution and they can perform poorly if the number of time periods is smaller than 20. In our case the sample covers 22 years. FMOLS is therefore a suitable estimator.

$$\Delta LTE_{i,t} = \alpha_i + \sum_{j=1}^{m} \delta_{i,j}^{e} \Delta LTI_{i,t-j} + \sum_{s=1}^{q} \gamma_{i,s} \Delta LTE_{i,t-s} + \lambda_{2i} ECM2_{i,t-1} + v_{i,t} \text{ -----(4)}$$

If λ is statistically significant in the first equation, but not significant in the second then we say that LTE Granger causes LTI, if the opposite happens we say that LTI Ggranger causes LTE. If φ is significant in both equations we say that there is a bi-directional relationship.

It was established in the previous section that income and expenditure of the selected banks are cointegrated. we have used both FEM and REM to estimate panel data VAR (1) of DLTI,and DLTE for eight 38 Banks as a group. The null hypothesis in the Hausman test is that the correlated REM is appropriate (i.e., the FEM and REM estimators do not differ substantially). If the null hypothesis is rejected, then we use FEM.

The Hausman test results indicate that the FEM is more suitable than the random effects model to estimate both the equations (3) and (4). Table 6 presents the estimated panel data bivariate vector error correction model (VECM) by FEM and the t-tests. In the short-run, total expenditure causes total income positively as indicated by the significant coefficient of Δ LTE(-1) in equation (3) and total income causes total expenditure positively as indicated by the significant coefficient of Δ LTI(-1) in equation (4).
Long-run causality is revealed by the statistical significance of the respective error correction terms using a t-test. In the long run, the estimated coefficients of ECT in equations of total income and total expenditure are significant at 10% and 1% respectively, implying that both total income and total expenditure could play an important adjustment role as the system departs from the long-run equilibrium. coefficient of the error correction term ECM1(-1) has an expected sign, negative, and it is significant. This means that expenditure is responsive to adjustments towards long-run equilibrium and it adjusts 0.08 percent of disequilibrium per year ,which implies that a Total income of the banks is slow to adjust to disequilibrium in the error term. Income is responsive to adjustments towards long-run equilibrium which implies that any deviation from the long-run equilibrium relationship will be faded away by 24 percent within a year, which implies that a change in total expenditure of the banks is better than change in income to adjust

to disequilibrium in the error term. The overall empirical results indicate that there is bidirectional Granger causality both in the short run, and in the long run.

Table 6: Results of Panel Granger Causality Tests -VECM

Model	Equation 3: $\Delta LTI_{i,t} = \alpha_i + \sum_{j=1}^{m} \delta_{i,j} \Delta LTI_{i,t-j} + \sum_{s=1}^{q} \gamma_{i,s} \Delta LTE_{i,t-s} + \lambda_{1i} ECM1_{i,t-1} + u_{i,t}$					
		Variable	Coefficient	Std. Error	t-Statistic	Prob.
Fixed Effects Model	Δ LTI	C	0.094036***	0.006364	14.77535	0.0000
		Δ LTI(-1)	0.165108***	0.063627	2.594954	0.0097
		Δ LTE(-1)	0.258473***	0.062295	4.149194	0.0000
		ECM1(-1)	-0.080917*	0.046639	-1.734988	0.0832
Direction of causality		Expenditure causes income both in the short -run and in the long -run				
	Equation 4: $\Delta LTE_{i,t} = \alpha_i + \sum_{j=1}^{m} \delta^{e}_{i,j} \Delta LTI_{i,t-j} + \sum_{s=1}^{q} \gamma_{i,s} \Delta LTE_{i,t-s} + \lambda_{2i} ECM2_{i,t-1} + v_{i,t}$					
Fixed Effects Model	Δ LTE	Variable	Coefficient	Std. Error	t-Statistic	Prob.
		C	0.074895***	0.006672	11.22490	0.0000

		Δ LTI(-1)	0.125570*	0.066539	1.887160	0.0595
		Δ LTE(-1)	0.379294***	0.065306	5.807937	0.0000
		ECM2(-1)	-0.242963***	0.051233	-4.742320	0.0000
Direction of causality	Income causes expenditure both in the short -run and in the long -run					

Notes: Dep.Var – Dependent Variable . Δ denotes first difference and the asterisks ***, ** and * indicates statistically significant at the 1%, 5% and 10% levels, respectively.

Conclusion

This study seeks to investigate the existence of long-run and short-run relationship between Bank-specific variables ,viz., Total income and Total expenditure during the period of 1992-2013. The empirical findings using Pedroni's heterogenous panel of cointegration disclosed that Total income and Total expenditure are cointegrated in the long run. The panel data Vector Error Correction Causality results reveal that there exists bidirectional causality between Total income and Total expenditure. To conclude, in the long run, both total income and total expenditure could play an important adjustment role as the system departs from the long-run equilibrium. An increase in total expenditure of the banks is better measure to adjust the disequilibrium in the long-run.

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APPENDIX

Table A1 – List of Banks included in the panel dataset (1992-2013)

NATIONALISED BANKS	OLD PRIVATE SECTOR BANKS
1. Allahabad Bank	1. Catholic Syrian Bank Ltd
2. Andhra Bank	2. City union Bank limited
3. Bank of Baroda	3. Federal Bank Ltd
4. Bank of India	4. Ing Vysya Bank Ltd
5. Bank of Maharashtra	5. Jammu & Kashmir Bank Ltd
6. Canara Bank	6. Karnataka Bank Ltd
7. Central Bank of India	7. Karur Vysya Bank Ltd
8. Corporation Bank	8. Lakshmi vilas Bank Ltd
9. Dena Bank	9. Nainital Bank Ltd
10. Indian Bank	10. Ratnakar Bank Ltd
11. Indian Overseas Bank	11. South Indian Bank Ltd
12. Oriental Bank of Commerce	12. Tamilnad Mercantile Bank Ltd
13. Punjab and Sind Bank	13. The Dhanalakshmi Bank Ltd

14. Punjab National Bank	**SBI AND ITS ASSOCIATES**
15. Syndicate Bank	1. State Bank of Bikaner and Jaipur
16. UCO Bank	2. State Bank of Hyderabad
17. Union Bank of India	3. State Bank of India
18. United Bank of India	4. State Bank of Mysore
19. Vijaya Bank	5. State Bank of Patiala
	6. State Bank of Travancore