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Linkage between Financial Development, Financial Crisis and Globalization in India: VARX and ARDL co-integration assessments

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Abstract
In this paper, the long-run causality between financial development, financial crisis and globalization—trade and financial openness—in India is investigated through the co-integration techniques of the VARX and ARDL methods. The main finding is that although the single impact of either trade or financial openness is uncertain, the simultaneous opening of the two sectors contributes to financial development. Another finding is that the growing presence of international trade is relevant to the occurrence of financial crisis. Policymakers, especially those of developing countries, need to recognize these effects of trade and financial openness in designing development plans.

Jel Code: E44, G01, O16, O24, O53

Keywords: *Financial development, financial crisis, trade openness, financial openness, cointegration, India.*

1. Introduction

Over recent decades, it has been long debated, if financial development leads to higher economic growth or not. That is, whether/how can the increasing extent of bank credit and/or stock market transaction be essential funds enabling an economy to grow fast? Since this issue is crucial, the literature on the relationship between financial development and economic growth—finance-growth nexus—has been long debated. Although empirical findings are mixed, the broad consensus is identified as follows: there is a positive long-run relationship between finance and growth, so that establishing well-functioning financial (both banking and equity) markets and institutions should be a policy priority (King and Levine, 1993; Demetriades and Hussein, 1996; Arestis et al., 2001). More recently, attention has shifted to other topics relevant to globalization—trade and financial openness—that has been considered as another key factor to stimulate economic development in the developing world. The argument is that trade and financial openness can improve resource allocation, lower prices for consumers and lead to more efficient production. Thus, external openness enables an economy to integrate into the global system, which results in imports of modern technology and productivity improvements. International organizations, therefore, commend opening up an economy to encourage growth and welfare in developing countries.

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Among several, we highlight two issues, given that the topic of globalization has not been adequately surveyed yet, especially in the context of case study. First, while financial development is vital for economic growth, it has been observed that some countries are financially developed, whereas others remain underdeveloped. One argument is that when a country is open to trade (exports and imports) and capital flows (capital account liberalization), it is more likely to bring benefits to financial development, as openness to both trade and finance can breed competition in financial markets[2]. Thus, external openness can increase economic growth through the effects on financial markets (Huang, 2006; Huang and Temple, 2005; Law, 2008; Baltagi et al., 2009). In this regard, Rajan and Zingales (2003) propose the 'interest-group' theory of financial development. According to the authors, incumbents oppose to developing financial markets as it produces fewer benefits for them than for potential competitors; the former can finance investment opportunities mainly through retained earnings, whereas the latter need external capital to start up their business. If a country is externally opened, both trade and finance will breed competition and threaten the incumbents. In other words, open borders help to check the incumbents and preserve competitive markets. External openness thus can bring what is necessary to make an economy more efficiency and more productive, not what is advantageous for the incumbents. Therefore, both trade and financial openness are to possess the catalytic effects that allow developing countries to transform their economies through financial deepening.

The second issue is relevant to financial crisis. Some researchers argue that financial deepening and external openness enhance stability in each economy, whereas others claim the opposite, i.e., financial deepening and openness to trade and finance can bring enormous risks—in the form of financial instability—that can far outweigh the potential benefits for most developing countries. Excessive financial deepening may have led to weakened financial systems which in turn associated with growth-inhibiting financial crises, as a result of widespread financial liberalizations in the late 1980s and early 1990s in developing countries that lacked the legal or regulatory infrastructure to exploit financial development successfully (Rousseau and Wachtel, 2011). In fact, severe financial crises—extreme level of financial instability—were observed across the developing world as evidence of the devastating consequence brought about by rapid and excessive financial deepening (e.g., Mexico's 1994-95 crisis; the Asian 1997-98 crisis). As financial crises imposed large welfare costs on crisis-hit economies, potential welfare gains from reducing the risk of financial crisis must be enormous for developing countries (Loayza et al. 2007).

The above issues are worthy to analyze, as a better understanding of the relationship between finance, crisis and external openness is urgent to enable policy makers—in particular those of developing countries—to appraise the costs and benefits of financial reforms in achieving development goals. While empirical studies have not yet found out a systematic linkage, the present paper conducts a case study in attempt to identify whether/how financial development, financial crisis and trade/financial openness are causally linked in India—the second largest emerging economy in the world. We are concerned with the causality between financial development and financial crisis that can be either finance→crisis or crisis→finance or finance↔crisis (bilateral). Emphasis is also put on what impact trade and financial openness and their interaction (trade openness×financial openness)—as weakly endogenous variables in the system—exhibit on the evolution of financial deepening and financial crisis in India.

This paper's contribution to the literature is described as follows. Cross-country and panel data studies have been dominant in the empirical literature analyzing the relationship between financial development and trade/financial openness (e.g. Baltagi et al., 2008; Huang,

[2] In this paper, the following terms are interchangeably used: 1) financial development, financial deepening and finance, 2) globalization and external openness, and 3) financial crisis and crisis.

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2006; Kim et al., 2010), but only a few case studies have been conducted to examine a specific country (e.g., Law, 2008). Hence, most of empirical evidence has been drawn from cross-country and panel data surveys that seek a single generalized result by averaging and pooling sample countries' data series, even though different countries have different paces and stories of financial development and liberalization. The present paper addresses such issues by focusing on India, which has been in the process of financial sector reforms since a severe financial crisis attacked the country in 1991 and thus provides interesting development experiences together with long enough, continuous data series[3]. Since economic reform and liberalization were initiated over last two decades, India has been transformed from a heavily controlled and regulated economy to an open and free-market one. In analyzing India's experience, the two approaches of vector error-correcting autoregressive model with exogenous variables (VARX) (Pesaran et al., 2000) and autoregressive distributed lag model (ARDL) (Pesaran et al., 2001) are employed. As these two techniques are founded on different concepts of cointegration, the use of them in a single analysis is innovation that is expected to attach more robustness to estimation. The present paper is structured as follows. The empirical strategy and data of this paper is given in the second section, and methodology is described in the third section. Empirical results are reported and discussed in the forth section, and conclusion comes in the end.

2. Empirical strategy and data

The model specification attempts to elucidate whether/how two aspects of financial development are causally related to financial crisis, respectively while those linkages are exposed to the factors of globalization, i.e., financial openness index (FOP), trade openness index (TOP) and their interaction (IA = FOP×TOP) that are taken as weakly exogenous variables into the estimation. The following empirical framework of equations is adopted for the assessment:

$$FD_t = f_1(FC_t, FOP_t, TOP_t, FOP_t \times TOP_t) \quad (1)$$

$$FC_t = f_2(FD_t, FOP_t, TOP_t, FOP_t \times TOP_t) \quad (2)$$

Equation (1) estimates the evolution of financial deepening in India. To this end, two alternative indexes of financial development (FD) are suggested (see Appendix, Table A.1). The first is the financial size index (FS) that is proxied by credit provided by commercial banks to the private sector (private credit); perhaps, the private credit is the most commonly used indicator of financial depth in the empirical literature because it is believed as the most relevant for measuring opportunities for new firms[4]. In our analysis, the private credit is measured in real terms, i.e., it is deflated by the consumer price index (CPI). The second is the financial efficiency index (FE) that is computed by the ratio of credit provided by commercial banks to the private sector to total domestic deposit (demand deposit + time deposit) as suggested by Beck et al. (2009). The rationale is that, if more credit is allocated—to the private sector but not to the public sector—relative to the volume of total domestic deposit, such a financial system is considered as more efficient and more competitive. Figure 1 shows two different evolutions of India's financial size and efficiency.

[3] There is general consensus that the 1991 crisis is one of the most important events for the Indian economy (Joshi and Little, 1996; Nayyar, 1996).

[4] Such studies as Al-Malkawi et al. (2012) use and regard the private credit as the efficiency (financial intermediation) index of financial depth for studying United Arab Emirates, but we use it as the size index. In case of India, the private credit and other indexes (e.g., money supply (money + quasi money)) exhibit multicollinearity.

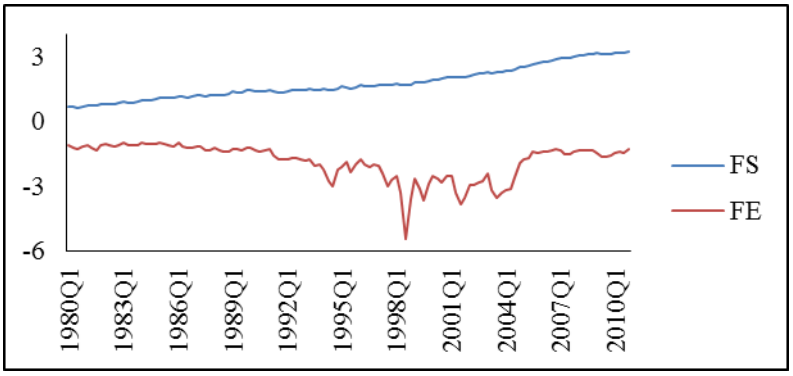

Figure 1: India's financial development

Meanwhile, the question of how financial crisis can arise in India due to the changing extents of financial depth and external openness is addressed through equation (2). While financial crises are generally classified into currency and banking crises in the literature (Kaminsky and Reinhart, 1999), we are more concerned with the former as India's 1991 crisis was indeed a typical event of currency explosion (Cerra and Saxena, 2002). Based on the assumption that India can have another currency crisis, the financial crisis index (FC) is created by measuring the volatilities in real exchange rate (ER) and the ratio of money supply to foreign exchange reserve (MTF), respectively and by integrating those volatilities through the principal component approach (see Appendix, Table A.2)[5,6]. Both real exchange rate and the ratio of money supply to foreign exchange reserve have been the proxies most commonly used for currency crisis (Kaminsky et al., 1998). As illustrated in Figure 2, India's FC depicts its peak over the crisis period of 1990 to 1991 over which India's 1991 crisis is readily identified by an extreme volatility in such calculated data. Thus, the element of financial crisis is taken into the analysis.

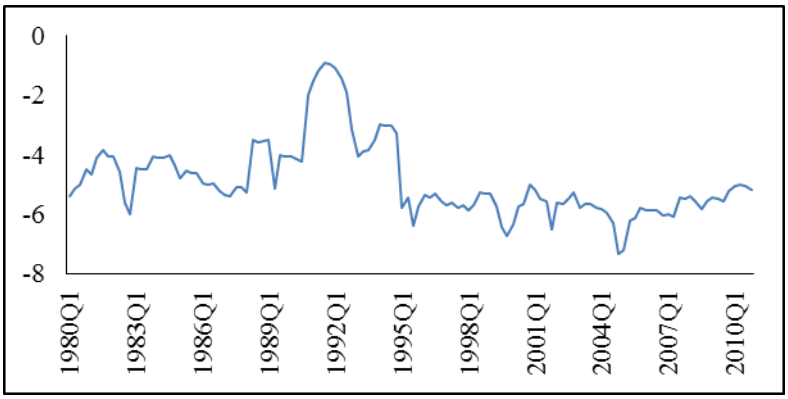

Figure 2: India's financial crisis

Furthermore, given the arguments of Lane and Milesi-Ferretti (2007) who suggest the indexes of external assets and liabilities (net foreign assets) for 145 countries, we originally

[5] The volatility in each of two variables is calculated by the squared returns (X_t^2). For example, the volatility of real exchange rate (ER) is computed as: $X_t^2 = [\log (ER_t/ER_{t-1})]^2$. Subsequently, we compute a 4-quarter rolling average of X_t^2 so as to search for more correlations among the two variables in constructing the FC.

[6] "Many of these (emerging) economies have experienced rapid growth but have also been subject to high volatility, most prominently in the form of severe financial crises that befell many of them during the last decade and a half" (Kose et al., 2006, pp. 177).

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produce the financial openness index (FOP) by combining the following elementary variables of financial openness through the principal component approach: 1) foreign exchange reserve, 2) net foreign assets held by commercial banks, and 3) financial account plus net errors and omissions, all of which are in real terms, i.e., are deflated by the CPI (see Appendix, Table A.3)[7]. As far as the trade openness index (TOP) is concerned, while there is some debate over which proxy is best for empirical analysis though (see Yanikkaya, 2003), we employ India's trade volume (exports + imports) that is measured in real terms deflated by the CPI. More importantly, following the procedures of Baltagi et al. (2009) and Law (2008), we put the interaction term (IA)—computed by IA = FOP × TOP—into the model specification in order for shedding light on the simultaneous hypothesis of Rajan and Zingales (2003), that is, whether both financial and trade liberalizations should be implemented at the same time. The plots of TOP, FOP and IA are given in Figure 3 where we confirm a variety of the trends of India's external openness. Finally, it is informed that, we use quarterly data sets covering the period 1980Q to 2011Q4, which correspond to the era of high economic growth, financial deepening and globalization in India. All the series are obtained from the IMF's *International Financial Statistics* (IFS) online database.

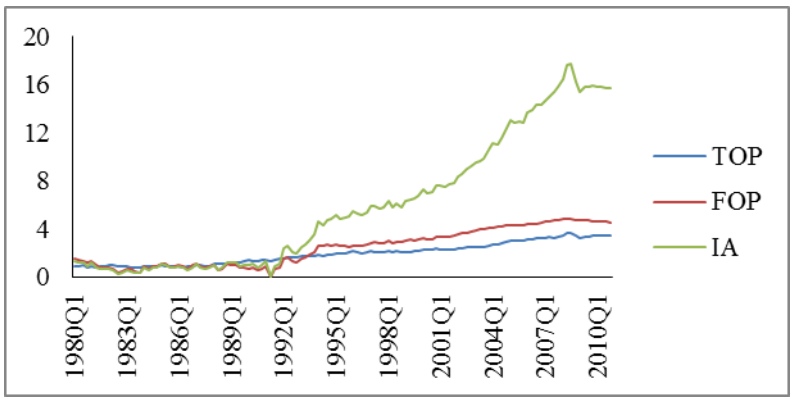

Figure 3: India's external openness

3. Methodology

The relationship between financial development, financial crisis and trade and financial openness in India should be investigated through the appropriate time series techniques. To this end, our analysis is initiated on the basis of a vector autoregressive (VAR) process. As Engle and Granger (1987) suggest that the VAR process is estimated in terms of dynamic adjustment, error correction models (ECMs) are formulated to detect the existence of a long-run relationship. We employ two approaches of cointegration: the vector error-correcting autoregressive model with exogenous variables (VARX) of Pesaran et al. (2000) and the autoregressive distributed lag model (ARDL) of Pesaran et al. (2001), which are founded on different concepts of cointegrating relationship. A simple VAR estimation just indicates that one variable Granger causes the other variable without information of causal direction (e.g., whether finance has positive or negative impact on crisis), whereas both the VARX and ARDL models show definite direction through the sign of each underlying variable's coefficient in the cointegrating space. Interestingly, whilst standard VAR models—including the VARX model—impose a strict condition that all underlying variables be integrated of order 1 ($I(1)$), the ARDL model is carried out even with the mixture of $I(0)$ and $I(1)$. Furthermore, the VARX model can treat some underlying variables as weakly exogenous variables that are taken into the cointegrating space but are not treated as endogenous

[7] The main arguments of Lane and Milesi-Ferretti (2007) are: 1) the level of net foreign assets is a fundamental determinant of external sustainability, and 2) many of the benefits of international financial integration (openness) are tied to gross holdings of foreign assets and liabilities.

variables. Recognizing these pros and cons, we believe that the use of the two techniques enables us to carry out more sophisticated analysis of cointegration and thus attaches more robustness to our findings on India's case study.

The assessment is started by checking the stationarity/integration of the underlying variables, i.e., whether each variable is *I*(0) or *I*(1). It has been pointed out that the results of unit root tests would be biased in many situations. Ever since Perron (1989) argued, the accuracy of unit root statistics is suspicious when a variable is exposed to a structural break; unit root tests may either over-reject the true null hypothesis or accept the null when it is false. To address these problems and identify the stationary property of each variable correctly, the three unit root tests of Elliott et al. (1996) (the GLS augmented Dickey-Fuller (ADF-GLS) test), Phillips and Perron (1988) (the PP test) and Lee and Strazicich (2003; 2004) (the LS test) are performed in our analysis. Especially, among several tests of unit root with structural break, the LS test is a newly developed test able to comprise at most two structural breaks and to endogenously determine at most two breaks in a series[8].

The subsequent procedures of the analysis are detailed for the VARX and ARDL estimations, respectively. On the one hand, the VARX assessment begins with the cointegration test of Johansen (1988) so as to find out the long-run relationship among the underlying variables. Given that cointegrated variables must have an error correction representation, the following error correction model is formulated:

$$\begin{bmatrix} \Delta FD_t \\ \Delta FC_t \end{bmatrix} = \alpha_{it} \begin{bmatrix} FD \\ FC \\ FOP \\ TOP \\ IA \end{bmatrix} + \sum_{j=1}^{p-1} \delta_{1j} \Delta FDS_{t-j} + \sum_{j=1}^{p-1} \delta_{2j} \Delta FC_{t-j} \qquad (3)$$

$$+ \sum_{j=1}^{p-1} \delta_{3j} \Delta FOP_{t-j} + \sum_{j=1}^{p-1} \delta_{4j} \Delta TOP_{t-j} + \sum_{j=1}^{p-1} \delta_{5j} \Delta IA_{t-j} + inpt + u_{it}$$

where [Δ*FD*, Δ*FC*] is a 2 x 1 vector of the dependent variables, [*FD, FC, FOP, TOP, IA*] is the cointegrating vector—the error correction term (ECT)—of the endogenous (FD and FC) and *I*(1) exogenous variables (FOP, TOP, IA), *p* is the lag order chosen for the system, and u_{it} is an error terms.

On the other hand, the ARDL frameworks are presented by the following error correction models:

$$\Delta FD_t = \alpha_{it} \begin{bmatrix} FD \\ FC \\ FOP \\ TOP \\ IA \end{bmatrix} + \sum_{j=1}^{p-1} \theta_{1j} \Delta FD_{t-j} + \sum_{j=1}^{p-1} \theta_{2j} \Delta FC_{t-j} \qquad (4)$$

$$+ \sum_{j=1}^{p-1} \theta_{3j} \Delta FOP_{t-j} + \sum_{j=1}^{p-1} \theta_{4j} \Delta TOP_{t-j} + \sum_{j=1}^{p-1} \theta_{5j} \Delta IA_{t-j} + inpt + u_{it}$$

$$\Delta FC_t = \alpha_{it} \begin{bmatrix} FC \\ FD \\ FOP \\ TOP \\ IA \end{bmatrix} + \sum_{j=1}^{p-1} \theta_{1j} \Delta FC_{t-j} + \sum_{j=1}^{p-1} \theta_{2j} \Delta FD_{t-j} \qquad (5)$$

$$+ \sum_{j=1}^{p-1} \theta_{3j} \Delta FOP_{t-j} + \sum_{i=1}^{p-1} \theta_{4j} \Delta TOP_{t-j} + \sum_{j=1}^{p-1} \theta_{5j} \Delta IA_{t-j} + inpt + u_{it}$$

At the first stage of the ARDL estimation, we need to conduct the bounds test that computes *F*-statistics in order for confirming the existence of long-run cointegrating relationships between the underlying variables, irrespective of whether those variables are *I*(0)

[8] The essence of Lee and Strazicich (2003; 2004) is that ADF-type unit root tests can exhibit size distortion and consequent spurious rejection of the null hypothesis when those tests are applied to unit root processes subject to break(s).

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or $I(1)$ (Pesaran and Pesaran, 2009)[9]. If the computed F-statistics exceed greater upper bound critical values, the null hypothesis is rejected and we conclude that there exists a cointegrating relationship between the underlying variables. If the computed value falls within lower and upper bound critical values, the result is inclusive so that we need check the results of unit root tests. At the second stage, the optimal lag order for each variable is selected by the Akaike information criteria (AIC)[10].

To give interference to our survey of India's case, we perform both the weak and strong exogeneity tests that have been commonly used by several time series studies (e.g., Demetriades and Hussein, 1996; Ang and McKibbin, 2007). First of all, the weak exogeneity test examines the null of H_0: $\alpha_i = 0$; indeed, this test is concerned with the evidence of long-run causality or the significance of the ECT coefficient. On the other hand, the strong exogeneity test imposes the nulls of H_0: all δ_{ij}'s = $\alpha_j = 0$ for the VARX estimation and H_0: all θ_{ij}'s = $\alpha_j = 0$ for the ARDL estimation, respectively. Thus, the strong exogeneity test is relevant to the overall causality in the system, regardless of long run or short run, i.e., time spans (see, Charemza and Deadman, 1997). Finally, it is noted that the two tests are founded on chi-square (X^2) statistics from the Wald test.

4. Empirical Results

We estimate the total of eight models that look at the causality between finance, crisis and external openness in India over the period 1980Q1 to 2010Q4. As given in Table 1, the robustness of those models is checked by four diagnostic tests. While some models exhibit the evidence of heteroscedasticity, non-normality and functional form problem, all of them are free from serial correlation at the 10% significance level or better. Thus, model specification is plausible to give us empirical findings that are statistically acceptable.

Table 1: Diagnostic test results (LM version)

Panel A: VARX				
Test statistic	**FS-VARX**	**FC--FS-VARX**	**FE-VARX**	**FC-FE-VARX**
Serial correlation	4.634 [.327]	6.393 [.172]	5.652 [.227]	3.623 [.459]
Functional form	1.054 [.305]	1.652 [.199]	3.548 [.060]	4.374 [.036]
Normality	26.31 [.000]	1.886 [.390]	719.3 [.000]	9.557 [.008]
Heteroscedasticity	0.028 [.867]	56.19 [.000]	6.014 [.014]	42.14 [.000]
Panel B: ARDL				
Test statistic	**FS-ARDL**	**FC-FS-ARDL**	**FE-ARDL**	**FC-FE-ARDL**
Serial correlation	6.252 [.181]	4.301 [.367]	6.757 [.149]	8.514 [.074]
Functional form	3.557 [.059]	10.47 [.001]	0.020 [.886]	4.146 [.042]
Normality	2.311 [.315]	11.32 [.003]	1110 [.000]	7.992 [.018]
Heteroscedasticity	0.972 [.324]	0.172 [.678]	18.36 [.000]	0.717 [.397]

4.1 Initial procedures

The order of integration of each underlying variable is examined through the three types of unit root test. In Table 2, the ADF-GLS and PP test statistics indicate that all FS, FE, FC, FOP, TOP and IA are non-stationary in their levels but become stationary after those variables are first-differentiated, so that all the variables are confirmed as $I(1)$. In addition, the unit root

[9] Actually, it is assumed that all the underlying variables are not $I(2)$ so that there is need to conduct the unit roots tests for the ARDL estimation.

[10] Other criteria also can be used, such as the Schwartz–Bayesian criteria (SBC). But we prefer the AIC as it tends to select longer lag orders than other criteria and quarterly data series are used for our analysis.

test with structural break(s) of Lee and Strazicich (2003; 2004) is conducted to attach more robustness to the analysis. In performing the Lee and Strazicich test, the total of four models—crash models A and AA and trend and break model C and CC—are computed either with one break or with two breaks. The results in Table 3 shows that except for a few, most of the variables are computed as *I*(1). Different unit root tests thus provide different estimates, especially when a structural break is mattered in computation. Given all the three tests' results, we conclude that all the underlying variables are suitable for our analysis of cointegration; indeed, it justifies the use of the VARX and ARDL assessments, in particular the latter can accept either *I*(0) variables or *I*(1) variables.

Table 2: ADF-GLS and PP test results (k = 5)

	ADF-GLS Test		**PP Test**	
	Inpt.	**Inpt. & trend**	**Inpt.**	**Inpt. & trend**
FS	1.814	-1.000	1.620	0.793
∆FS	-2.210**	-3.703**	-11.261**	-11.498**
FE	-1.350	-1.641	-2.383	-2.401
∆FE	-4.541**	-5.310**	-11.461**	-11.458**
FC	-2.006	-2.105	-2.488	-2.971
∆FC	-4.314**	-5.393**	-10.904**	-10.857**
TOP	2.230[§]	-0.986	0.792	-2.946
∆TOP	-3.851**	-4.833**	-13.135**	-13.359**
FOP	0.079	-1.321	0.027	-3.458
∆FOP	-1.869*	-3.256**	-12.793**	-12.875**
IA	1.141	-0.915	1.191	-2.316
∆IA	-2.546**	-4.034**	-10.519**	-10.817**

Notes: (**) 5% and (*) 10% level of significance. ([§]) The null cannot be rejected at the 1% level.

Table 3: Lee and Strazicich test results (k = 5)

	Crash model		**Trend break model**	
	A (one break)	**AA (two breaks)**	**C (one break)**	**CC (two breaks)**
FS	-1.498	-1.756	-3.377	-4.613
∆FS	-2.963	-3.284	-5.789***	-6.964***
FE	-2.287	-2.653	-4.413**	-6.972***
∆FE	-5.130***	-5.239***	-6.342***	-7.714***
FC	-3.066	-3.6733	-4.083	-5.926**
∆FC	-6.490***	-6.692***	-7.114***	-8.133***
TOP	-1.511	-1.669	-2.243	-4.040
∆TOP	-2.476	-3.210	-6.793***	-8.023***
FOP	-1.526	-1.710	-5.201***	-5.270
∆FOP	-11.761***	-12.286***	-12.826***	-12.848***
IA	-1.228	-1.300	-2.842	-3.927
∆IA	-4.742***	-5.176***	-8.624***	-9.165***

Notes: (***) 1%, (**) 5% and (*) 10% level of significance.

The next procedure starts with conducting the Johansen (1988) cointegration test for the VARX analysis, in which FOP, TOP and IA are treated as *I*(1) exogenous variables in the cointegrating vector[11]. For the Johansen test, it is essential to determine the lag order, as the test is highly prone to the choice of lag length. The trace statistics in Table 4 shows that there is a single cointegration relationship (r = 1) between FS and FC and between FE and FC, respectively. Meanwhile, the bounds test is implemented for the ARDL analysis with the maximum lag order of five treating FS, FE and FC as the dependent variables. The results in

[11] For details, see Pesaran et al. (2000).

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Table 5 report that a cointegration relationship is discovered for all those variables in terms of the ARDL cointegration.

Table 4: Johansen cointegration test results (trace statistics; $k = 5$)

Panel A		
Endogenous variables: FS, FC		
I (1) exogenous variables: TOP, FOP, IA		
Deterministic components: intercept (unrestricted), trend (restricted)		
Null	**Alternative**	**Statistic**
$r = 0$	$r >= 1$	52.20**
$r <= 1$	$r = 2$	20.94
Panel B		
Endogenous variables: FE, FC		
I (1) exogenous variables: TOP, FOP, IA		
Deterministic components: intercept (restricted)		
Null	**Alternative**	**Statistic**
$r = 0$	$r >= 1$	46.75**
$r <= 1$	$r = 2$	20.09

Notes: (**) 5% significance level.

Table 5: Bound test results (*F*-static version)

Panel A				
Underlying variables: FS, FC, TOP, FOP, IA				
Deterministic components: intercept, trend				
Dependent variable/F-statistic/Selected lags				
FS	**FC**	**Significance level**	**Lower bound**	**Upper bound**
5.174**	9.348**	95%	3.609	4.745
(4, 0, 4, 2, 2)	(4, 4, 0, 4, 0)	90%	3.099	4.132
Panel B				
Underlying variables: FE, FC, TOP, FOP, IA				
Deterministic components: intercept				
Dependent variable/F-statistic/Selected lags				
FE	**FC**	**Significance level**	**Lower bond**	**Upper bound**
2.867*	8.997**	95%	2.933	4.107
(3, 0, 0, 0, 4)	(4, 0, 3, 2, 3)	90%	2.486	3.570

Notes: (**) 5% and (*) 10% level of significance. The optimal lag order of each underlying variable given in brackets is selected by the AIC.

4.2 Identified cointegrating vectors

Tables 6 and 7 present identified cointegrating vectors together with α (ECT coefficient) and weak exogeneity test results estimated by the VARX and ARDL estimations. We first look at the ECT coefficients, which measure the speed of adjustment back to the long-run equilibrium whenever there is a deviation from the steady state in the cointegrating system; importantly, the ECT coefficient is requested to have a negative sign. As given in the second columns of Tables 6 and 7, all the coefficients of eight models are statistically significant while demonstrating acceptable sizes and negative signs.

As far as financial development is concerned, financial size and financial efficiency are separately mattered in our analysis. For the financial size (FS), the adjustment speed is found out 6% by the VARX and 13% by the ARDL, respectively. Likewise, for the financial efficiency (FDE), it is estimated as 11.8% by the VARX and 23.2% by the ARDL, respectively. On the other hand, the adjustment speed of financial crisis (FC) ranges more widely from 24.8% to 50.2% across four models. In particular, when the financial size is

taken into account, the speed appears as 40% in the VARX estimation and as 50.2% in the ARDL estimation, respectively. Thus, it is detected that the adjustment speed is relatively faster in the order of financial crisis, financial efficiency and financial size. Moreover, we look at the direction of one underlying variable's impact on others, i.e., one variable has positive or negative impact on the other variable; it is identified by the sign of each variable in the cointegrating vector. According to the first columns of Tables 6 and 7, in which standard errors are provided in brackets, no consensus is obtained for the directions. However, since all the ECT coefficients are significant at the 10% level or better, we consider that all the underlying variables shape the cointegrating system and so collectively exhibit impact on each dependent variable.

Table 6: VARX cointegrating vectors

Panel A Financial development indictor: FS		
Cointegrating vector	**ECT coefficient**	**W.E. test**
$FS = \underset{(0.097)}{0.161}FC - \underset{(0.371)}{0.924}TOP + \underset{(0.223)}{0.060}FOP + \underset{(0.022)}{0.158}IA + \underset{(0.004)}{0.020}trend$	-0.060*	3.582 [.058]
$FC = \underset{(3.736)}{6.208}FS + \underset{(1.956)}{5.734}TOP - \underset{(1.173)}{0.376}FOP - \underset{(0.621)}{0.980}IA - \underset{(0.071)}{0.121}trend$	-0.400***	11.98 [.001]
Panel B Financial development indicator: FE		
Cointegrating vector	**ECT coefficient**	**W.E. test**
$FE = \underset{(0.972)}{1.033}FC - \underset{(4.247)}{5.793}TOP + \underset{(2.668)}{1.146}FOP + \underset{(0.173)}{0.703}IA + \underset{(5.891)}{7.101}$	-0.118***	10.12 [.001]
$FC = \underset{(0.911)}{0.968}FE + \underset{(1.660)}{5.608}TOP - \underset{(1.571)}{1.110}FOP - \underset{(0.599)}{0.681}IA - \underset{(1.186)}{6.874}$	-0.248***	8.821 [.003]

Notes: (***) 1% and (*) 10% level of significance. Standard errors are given in brackets.

Table 7: ARDL cointegrating vectors

Panel A Financial development indictor: FDS		
Cointegrating vector	**ECT coefficient**	**W.E. test**
$FS = \underset{(0.048)}{-0.060}FC - \underset{(0.290)}{0.421}TOP - \underset{(0.100)}{0.279}FOP + \underset{(0.038)}{0.187}IA + \underset{(0.005)}{0.015}trend + \underset{(0.246)}{1.102}$	-0.130*	3.689 [.055]
$FC = \underset{(1.813)}{2.529}FS + \underset{(1.057)}{3.939}TOP - \underset{(0.711)}{1.005}FOP - \underset{(0.291)}{0.388}IA - \underset{(0.071)}{0.064}trend - \underset{(1.950)}{7.601}$	-0.502***	47.91 [.000]
Panel B Financial development indicator: FE		
Cointegrating vector	**ECT coefficient**	**W.E. test**
$FE = \underset{(0.168)}{-0.211}FC - \underset{(0.860)}{0.568}TOP - \underset{(0.500)}{2.163}FOP + \underset{(0.133)}{0.616}IA - \underset{(1.135)}{0.392}$	-0.232***	9.880 [.002]
$FC = \underset{(0.268)}{-0.132}FE + \underset{(0.802)}{3.644}TOP - \underset{(0.607)}{2.649}FOP + \underset{(0.200)}{0.003}IA - \underset{(0.712)}{5.730}$	-0.391***	40.12 [.000]

Notes: (***) 1% and (*) 10% level of significance. Standard errors are given in brackets.

4.3 Financial development

Tables 8 and 9 show the findings on how two aspects of India's financial development—financial size (FS) and financial efficiency (FE)—are influenced by those variables of financial crisis (FC), trade openness (TOP), financial openness (FOP) and interaction term (IA), respectively. To begin with, the fifth columns of Tables 8 and 9 provide "Yes" and "No" results that are based both on the strong exogeneity statistics from the VARX and ARDL assessments (the third columns) and on the direction of one variable's impact on financial size/financial efficiency (the forth columns); the latter is identified by the coefficient's sign and *t*-statistic significance of each underlying variable in the cointegrating vector. We thus put a strict condition to make inference: only when these two are statistically significant at the 10% level or better, "Yes" is given to each estimate. The findings on India's

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financial development are summarized in Table 10. According to the table, trade openness is negative to financial size in the VARX estimation, whereas financial openness is estimated as negative both to financial size and to financial efficiency in the ARDL estimation. The most important discovery is that the interaction term has a significant positive impact both on financial size and on financial efficiency, as identified by all the VARX and ARDL models. Hence, the evidence from India implies that development strategies prioritizing both trade and financial openness are commendable to enhance financial deepening.

Table 8: Causality test results (financial size)

Financial development indicator: FS H_0: Crisis/Trade openness/Financial openness/Interaction does not cause financial size				
Model	**Regressors**	**Causality Test Statistic**	**Direction**	**Result**
FS-VARX	ECT(-1)	CHSQ(1) = 3.582*	—	—
	ΔFCs & ECT(-1)	CHSQ(5) = 7.208	Positive***	No
	ΔTOPs & ECT(-1)	CHSQ(6) = 12.862**	Negative***	Yes
	ΔFOPs & ECT(-1)	CHSQ(6) = 13.451**	Positive	No
	ΔIAs & ECT(-1)	CHSQ(6) = 14.352**	Positive***	Yes
FS-ARDL	ECT(-1)	CHSQ(1) = 3.689*	—	—
	ΔFC & ECT(-1)	CHSQ(2) = 9.291***	Negative	No
	ΔTOPs & ECT(-1)	CHSQ(5) = 26.507***	Negative	No
	ΔFOPs & ECT(-1)	CHSQ(3) = 7.662*	Negative***	Yes
	ΔIAs & ECT(-1)	CHSQ(3) = 8.035**	Positive***	Yes

Notes: (***) 1%, (**) 5% and (*) 10% level of significance. All the ECTs exhibit a negative sign.

Table 9: Causality test results (financial efficiency)

Financial development indicator: FE H_0: Crisis/Trade openness/Financial openness/Interaction does not cause financial efficiency				
Model	**Regressors**	**Causality Test Statistic**	**Direction**	**Result**
FE-VARX	ECT(-1)	CHSQ(1) = 10.118***	—	—
	ΔFCs & ECT(-1)	CHSQ(5) = 11.054**	Positive	No
	ΔTOPs & ECT(-1)	CHSQ(6) = 20.721***	Negative	No
	ΔFOPs & ECT(-1)	CHSQ(6) = 10.625	Positive	No
	ΔIAs & ECT(-1)	CHSQ(6) = 12.648**	Positive***	Yes
FE-ARDL	ECT(-1)	CHSQ(1) = 9.880***	—	—
	ΔFC & ECT(-1)	CHSQ(2) = 13.666***	Negative	No
	ΔTOP & ECT(-1)	CHSQ(2) = 10.076***	Negative	No
	ΔFOP & ECT(-1)	CHSQ(2) = 12.505***	Negative***	Yes
	ΔIAs & ECT(-1)	CHSQ(5) = 24.703***	Positive***	Yes

Notes: (***) 1% and (**) 5% level of significance. All the ECTs exhibit a negative sign.

Table 10: Summary of India's financial development

Panel A: Financial Size	
Model	**Result**
FS-VARX	Trade Openness→Financial Size (-)
	Interaction→Financial Size (+)
FS-ARDL	Financial Openness→Financial Size (-)
	Interaction→Financial Size (+)
Panel B: Financial Efficiency	
Model	**Result**
FE-VARX	Interaction→Financial Efficiency (+)
FE-ARDL	Financial Openness→Financial Efficiency (-)
	Interaction→Financial Efficiency (+)

4.4 Financial crisis

In the present framework of the VARX and ARDL investigation, we also investigate whether/how India's financial crisis (FC) is impacted by the changing extents of financial development and openness. The relevant findings are given in Tables 11 and 12 where financial crisis is regressed on other underlying variables while either financial size or financial efficiency—as the financial development indicator—is interchangeably taken into the computation. Following the same procedures as employed for the financial development, we present the strong exogeneity statistics, the direction of each variable's influence on financial crisis and Yes/No results in Tables 11 and 12. Table 13 highlights some important finings on India's financial crisis. As detected by all the four models, one notable finding is that the increasing level of trade openness significantly involves the occurrence of financial crisis in India. Moreover, although identified by a single model, each of financial openness and interaction term can be preventive against financial crisis, as the formers have a negative impact on the latter. Besides, financial size is a positive determinant of financial crisis as estimated by the VARX model, whereas no significant result is discovered for the hypothesis of financial efficiency causing financial crisis.

Table 11: Causality test results (crisis with financial size)

H_0: Financial size/Trade openness/Financial openness/Interaction does not cause financial crisis

Model	Regressors	Causality Test Statistic	Direction	Result
FC-FS-VARX	ECT(-1)	CHSQ(1) = 11.980***	—	—
	ΔFSs & ECT(-1)	CHSQ(5) = 14.050**	Positive***	Yes
	ΔTOPs & ECT(-1)	CHSQ(6) = 15.274**	Positive***	Yes
	ΔFOPs & ECT(-1)	CHSQ(6) = 17.595***	Negative	No
	ΔIAs & ECT(-1)	CHSQ(6) = 17.463***	Negative*	Yes
FC-FS-ARDL	ECT(-1)	CHSQ(1) = 47.915***	—	—
	ΔFSs & ECT(-1)	CHSQ(5) = 50.867***	Positive	No
	ΔTOP & ECT(-1)	CHSQ(2) = 48.042***	Positive***	Yes
	ΔFOPs & ECT(-1)	CHSQ(5) = 51.662***	Negative	No
	ΔIA & ECT(-1)	CHSQ(2) = 48.022***	Negative	No

Notes: (***) 1%, (**) 5% and (*) 10% level of significance. All the ECTs exhibit a negative sign.

Table 12: Causality test results (crisis with financial efficiency)

H_0: Financial efficiency/Trade openness/Financial openness/Interaction does not cause financial crisis

Model	Regressors	Causality Test Statistic	Direction	Result
FC-FE-VARX	ECT(-1)	CHSQ(1) = 8.821***	—	—
	ΔFEs & ECT(-1)	CHSQ(5) = 12.583**	Positive	No
	ΔTOPs & ECT(-1)	CHSQ(6) = 11.518*	Positive***	Yes
	ΔFOPs & ECT(-1)	CHSQ(6) = 15.390**	Negative	No
	ΔIAs & ECT(-1)	CHSQ(6) = 13.547**	Negative	No
FC-FE-ARDL	ECT(-1)	CHSQ(1) = 40.116***	—	—
	ΔFE & ECT(-1)	CHSQ(2) = 40.550***	Negative	No
	ΔTOPs & ECT(-1)	CHSQ(4) = 43.761***	Positive***	Yes
	ΔFOPs & ECT(-1)	CHSQ(3) = 40.320***	Negative***	Yes
	ΔIAs & ECT(-1)	CHSQ(4) = 42.107***	Positive	No

Notes: (***) 1%, (**) 5% and (*) 10% level of significance. All the ECTs exhibit a negative sign.

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Table 13: Summary of India's financial crisis

Panel A: Crisis with Financial Size	
Model	Result
FC-FS-VARX	Financial Size→Crisis (+)
	Trade Openness→Crisis (+)
	Interaction→Crisis (-)
FC-FDS-ARDL	Trade Openness→Crisis (+)
Panel B: Crisis with Financial Efficiency	
Model	Result
FC-FE-VARX	Trade Openness→Crisis (+)
FC-FE-ARDL	Trade Openness→Crisis (+)
	Financial Openness→Crisis (-)

4.5 Discussions

We discuss some policy implications drawn from the analysis of India's financial development, crisis and globalization. First of all, the hypothesis that trade and financial openness can assist India's financial deepening is fairly supported by empirical findings. Specifically, even though the marginal effects of trade and financial openness are negative to financial deepening, their interaction term (TOP×FOP) is detected as significantly positive to both financial size and financial efficiency, as estimated by all the four models (see Table 10). Therefore, we draw the following inference: trade and financial sectors should be simultaneously liberalized to encourage financial development in a balanced manner, that is, both of financial size and efficiency are enhanced by the interaction of trade and financial openness. The present paper clearly supports the simultaneous opening of the two sectors suggested by Rajan and Zingales (2003), but not McKinnon's (1993) sequencing view of opening trade first and finance second[12]. Furthermore, it has been observed that some countries are financially developed, whereas others remain underdeveloped, so that different countries may have various extents of financial depth and economic growth; this might be in part due to diverse openness of trade and financial market among different countries. Although India is a late-comer in terms of external openness as compared with other Asian economies, it has been in the process of liberalization, achieving nearly 8% GDP growth over a few decades. One policy implication is that policymakers, especially those of developing economies, should recognize the catalytic effect of trade and financial openness that is applicable to make financial development more productive and help bring about more economic achievements. It is considered that globalization has forced India to do what is necessary to make the country productive.

We also investigate whether financial development and trade and financial openness either associate with stability or rather expose India to more financial instability and ultimately to severe financial crisis. The main finding is that the growing extent of trade openness significantly involves the occurrence of financial crisis, as found out by all the four models (see Table 13). While India has emerged as one of fast-growing traders over recent decades, such structure—trade liberalization can result in financial instability and eventually bring financial chaos to the economy—has been formed. Hence, another policy implication is that although international trade has been long and widely recognized as one of the most effective devices for economic growth, it possesses potential risk that must be taken into account and well managed to avoid. On the other hand, as supported by limited evidence

[12] Our results of India's causality between financial development and openness can be compared with those of Law (2008) who examines Malaysia and concludes that the simultaneous openness hypothesis is not supported in promoting financial deepening (both banking and stock market development) in Malaysia.

though, the increasing level of the interaction between trade and financial openness can be defensive against financial crisis (see Table 13). This finding points out a kind of possibility that the simultaneous opening will bring stability to an economy. It is plausible to assume that when trade liberalization has been in process, the structure of an economy has been converted as follows: A growing trade sector, which provides productive investment opportunities, is always starving to finance, whereas the economy whose financial market is less developed is in danger of credit crunch. If capital account liberalization is implemented, the economy attracts sufficient funds so that the increasing demand for credit is timely met.

5. Conclusion

This paper examines the long-run, causal relationship between financial development, financial crisis and trade and financial openness in India—one of the largest emerging economies—by using the cointegration techniques of the VARX and ARDL methods. As far as financial development is concerned, we detect the "interaction-led-finance", that is, while the single impact of either trade or financial openness is not established, the simultaneous opening of the two sectors can successfully boost both of financial size and efficiency. This evidence agrees with Rajan and Zingales' (2003) argument and differs from those of Law's (2008) analysis of Malaysia and Baltagi et al. (2009) panel data analysis developing and industrialized economies. This fact stresses the need of conducting the in-depth, single country analysis rather than the cross-country and panel data assessment, because different countries, which have a variety of peaces and ways of liberalization, are more likely to exhibit different estimates albeit on the same topic.

Another important finding is the "trade-led-crisis", that is, the growing presence of the trade sector associates with the occurrence of financial crisis in India. Trade boom is welcome for developing economies to achieve financial development and high economic growth, but it will magnify financial instability. Indeed, India was hit by severe financial crisis in 1991 after experiencing trade and financial booms over the late 1980s. Policymakers, specifically those of developing countries, need to recognize these contradicting impacts of external openness so as to design productive plans of development.

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Appendix

Table A.1: Underlying variables

Underlying Variable	Description
Financial size (FS)	FS = log (PC/CPI) where PC is private credit (line 32D) and CPI is consumer price index (line 64).
Financial efficiency (FE)	FE = log [PC/(DD + TD)] where DD is demand deposits (line 24) and TD is time deposits (line 25).
Financial crisis (FC)	FC = ER + MTF (The elementary variables are merged by the principal component method to make FC. See Appendix 2).
Trade openness (TOP)	TOP = log [(X + I)/CPI] where X is exports (line 70) and I is imports (line 71).
Financial openness (FOP)	FOP = FRTM + FATM + FETM (The elementary variables are merged by the principal component method to make FOP. See Appendix 3)
Interaction (IA)	IA = TOP × FOP

Notes: All the "lines" refer to those of the International Financial Statistics (IFS).

Table A.2: Elementary variables of financial Crisis

Elementary Variable	Description
Exchange rate (ER)	ER = NER × (USCPI/ICPI) where NER is nominal exchange rate (line RF) and USCPI and ICPI are US and India's consumer price indexes, respectively.
Money supply/ foreign exchange reserve (MTF)	MTF = M/FR where M is money supply (line 35L) and FR is foreign exchange reserve (line 1D).

Notes: All the "lines" refer to those of the International Financial Statistics (IFS). Each variable is measured as a four-quarter rolling average of squared returns, that is, $[\log (ER_t/ER_{t-1})]^2$ and $[\log (MTF_t/MTF_{t-1})]^2$.

Table A.3: Elementary variables of financial openness

Elementary Variable	Description
Foreign exchange reserve/money supply (FRTM)	FRTM = log (FR/M) where FR is foreign exchange reserve (line 1D) and M is money supply (line 35L).
Commercial banks' net foreign assets/ money supply (FATM)	FATM = log (FA/M) where FA is commercial banks' net foreign assets (line 31N).
Financial account plus net errors & omissions/money supply (FETM)	FETM = log (FE/M) where FAE is financial account plus net errors & omissions (lines 78BJD & 78CAD).

Notes: All the "lines" refer to those of the International Financial Statistics (IFS).