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Does Technological Progress, Trade, or Financial Globalization Stimulate Income Inequality in India?

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Abstract

The main purpose of the present research is to analyze the effects of trade, financial globalization, and technological progress on income inequality in the Indian economy over the period from 1982 to 2018. For this purpose, the study uses economic growth, financial globalization, trade openness, technological development, and economic inequality variables with appropriate proxies. The study employs the Auto Regressive Distributed Lag (ARDL) approach to co-integration and VECM based Granger causality approach to estimate both the short-run and long-run relationship and causality among variables. Using the ARDL bounds test, the study finds a long-run co-integrating relationship existing among the variables in the model. The study confirms the existence of a positive and significant impact of technological progress on income inequality. Further, globalization's limited impact reflects two offsetting tendencies; trade globalization is associated with a reduction in income inequality, while financial globalization is related to an increase in inequality. The results of VECM based Granger causality approach further confirm that technological progress, trade, and financial globalization causes income inequality both directly and indirectly through economic growth and inflation. In case of India, the results of this research can significantly facilitate stakeholders and policymakers in devising policies towards effective globalization and technological innovation for inclusive growth.

Keywords: Income Inequality, Financial Globalization, Trade Globalization, Technological Progress, ARDL, India

JEL Classification Code: F13, G32, O11, O15

1. Introduction

Technological progress and globalization are widely regarded as two of the main drivers of recent economic growth. One can broadly think of technological progress as the development of methods and the spread of new ideas that enhance productivity and efficiency. On the other hand, globalization acts as a catalyst of technological change that facilitates the diffusion of ideas and methods worldwide through trade openness and foreign direct investment Jaumotte et al. (2013), Bong & Premaratne (2019). Although these drivers are considered as cornerstones of the unprecedented growth of the world economy over the last few years, however, their distributional consequences are less explored. As rising income inequality across most countries over the past two decades poses one of the most significant challenges to the policymakers, the issue of income inequality has recently regained its importance in the literature.

Understanding the cause of income inequality is fundamental to devise the right policy to reduce the gap between rich and poor. Reducing inequality remains essential not just from the perspective of achieving a more egalitarian income distribution but also because rising inequality may reflect unequal access of economic opportunities to all. This asymmetry may itself limit the growth potential of the economy by not allowing all economic agents to fully exploit the new opportunities created by globalization and also limiting the productive capacity of an economy by not reallocating (or deploying) the capital and labour as efficiently as possible (Mallick et al. 2020; Kumar

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& Paramanik, 2020). Moreover, to the extent that economies are subjected to periodic shocks of various kinds, limiting the growth in the short run, greater income inequality makes the population vulnerable to loss of income and poverty.

An extensive literature has documented widening income inequality and job polarization due to globalization and technology developments (Autor et al. 2008; Bui, 2019). It has been argued that skill-biased technological changes (especially the information and communication technology revolution) are the major cause of income disparity across the world economies. Globalization (especially outsourcing inputs to a firm in low-wage countries) has also been considered as an important factor in income disparities. In the above context, the present study proposes to analyse the empirical relationship of the effect of globalization, technological development, and economic growth on income inequality.

The Indian economy, a latecomer to the process of economic reforms and liberalization, joined the club in the 1990s in the wake of a severe external balance crisis.

Financial sector reforms were also initiated as a part of the economic reform programme. Consequently, financial globalization and trade globalization initiation has led to an increase in the inward flow of foreign direct investment to the economy from 1991. As a result, the economic liberalization process was introduced under the Structural Adjustment Programme (SAP) with the IMF and the World Bank's support. This culminated in a series of economic reforms in 1991 and a host of industrial policy reforms. NIP (1991) recognized the role of FDI in the process of industrial development in India in terms of bringing greater competitiveness and efficiency and also modernization, technological up-gradation, creating a sound base for export promotion, and above all integrating India with the rest of the world.

As far as the amount of foreign direct investment in India has from US$ 165 million in 1991 to US$ 4222 million in 2001, however, it declined to US$ 2634 in the year 2003, and again in 2004, it demonstrates an increasing trend. Similarly, the GDP growth rate fluctuated between 1991 and 2009. With a negative growth rate during 1999-2003, it increased to 183.6% in 2006. The CAGR of actual FDI inflow was 24.28% during 1991-2008. The inward FDI flow to India stands presently at US$39.32 billion. As far as growth in the trade openness indicator ((Exports + Imports) / GDP) is concerned, India's average value from 1990 to 2015 was 31.44 percent. So, financial globalization has proceeded at a very rapid pace over the past three decades. Simultaneously, as measured by various indicators, technological developments have increased significantly during the period. As shown in Table 1 above, Resident Patents, High technology Exports as % of manufacturing exports, R&D Expenditure % of GDP, Telephone Connections (per 100) and Internet Uses (per 100) have demonstrated significant growth since 1990. This is quite important in our analysis as technological progress will play a role in explaining the rising inequality in the country, as demonstrated by the Gini coefficient figure in the above table.

Hence, keeping in view the above facts and the figures exhibited by the Indian economy during the last few decades, and the importance of such measures, this study proposes to address the following research issues;

(i) First, to assess to what extent technological progress, trade, and financial globalization of the Indian economy stimulate income inequality?
(ii) Second, to check which factors stimulate income inequality, and which factors reduce income inequality in India?
(iii) Third, to draw implications of the research for stakeholders and policymakers in devising short term as well as long term policies related to technological innovation, trade, and financial globalization in order to sustain long term economic growth in India.

The rest of the paper is designed as following. Section 2 reviews the literature related to the topic Section 3 comprises detailed econometric methodology used in the study. Section 4 presents the discussion of the empirical results of the study, and Section 5 presents the summary and conclusion of the research.

Table 1: Selected Indicators of Globalization, Economic Growth, Technology Development, and Inequality for India

Indicators	1990	1995	2000	2005	2010	2015
Gini Coefficient	30.9	32.5	34.2	36.78	36.95	39.91
FDI as percentage of GDP	0.027	0.585	0.752	0.871	3.657	2.2
(Exports + Imports) / GDP	15.23	22.43	26.54	41.30	48.23	54.878
Per capita real GDP growth	3.1	3.3	3.6	4.8	5.4	6.8
Resident Patents	1267	1545	2206	4721	8853	12040
High technology Exports as % of manufacturing exports	4.692	5.804	6.255	5.803	7.1805	8.5862
R&D Expenditure % of GDP	0.612	0.674	0.7132	0.7908	0.8312	0.8725
Telephone Connections (per 100)	0.655	1.253	3.112	4.451	2.910	2.13
Internet Uses (per 100)	0.0113	0.26	0.5275	2.388	7.5	18.0

Source: World Bank Database

2. Literature Review

The existing literature on the key aspects of financial development, economic growth, technological development, and globalization as income inequality sources are linked in this paper. It reflects the effects of technological development, financial and trade liberalization policies in changing the income distribution of a group of countries or specific economy.

2.1. Finance-Growth-Inequality

Over the last four decades, researchers have been growing interest in analyzing the linkage between financial development and economic growth. (Anderson & Tarp, 2003; Jalilian & Krikpatrick, 2005; Levive et al., 2000; Pagano, 1993; Sehrawat and Giri, 2015). Levine (1997) confirms that the economies have experienced long-run economic growth, which has well-developed banking and financial system. However, Kirkpatrick (2000) showed the role of well-functioning financial system in the mobilization of savings, resource allocation, and facilitation of risk management, which in turn provides support for capital accumulation, improve the efficiency of investment, and promotes innovations in technology and hence contributes economic growth. Similarly; Goldsmith (1969), McKinnon (1973), King and Levine (1993), Shan (2005), Ma and Jalil (2008), Shahbaz (2010), and Sehrawat and Giri (2015) identified the degree as well as the effectiveness of financial development on sustained economic growth, physical capital accumulation and economic efficiency in different economies.

On the other hand, existing literature has highlighted various aspects of financial development associated with income inequality and poverty. For example, Banerjee and Newman (1993) and Galor and Zeira (1993) have found out that the financial market and credit market development improve income distribution. They suggested that the initial income gap would not be reduced unless financial markets are sound. Similarly, Canavire-Bacarreza and Rioja (2009) documented that due to lack of collateral and brief credit history, poor entrepreneurs are affected by financial market imperfections. Similarly, Behrman et al. (2001), Dollar and Kraay (2002), Beck et al. (2004) found that high transaction costs of the financial sector are beyond the affordability of the poor. Hence, poor individuals are unable to come out of the problem of income inequality and poverty. Further, deficiencies in the money markets regarding asymmetric information, intermediation, and transaction costs restrict poor people from getting loans from financial institutions. Hence, accessibility to financing acts as the bottleneck of development in many underdeveloped economies.

2.2. Globalization, Technological Development, and Income Inequality

The principal analytical link between trade liberalization and income inequality provided by economic theory is derived from the Stolper-Samuelson theorem from the Heckscher-Ohlin model. It implies that increased trade openness in a developing country where low-skilled labour is abundant would increase their wage. A decrease in the wages of the high-skilled labour will reduce income inequality.

The empirical literature on the impact of trade globalization on income distribution is also extensive. Blanchard and Willmann (2011), Costinot and Vogel (2010), Falvey et al. (2010), and Sampson (2014) emphasized the traditional sector adjustment effect of globalization on income distribution. Egger and Kreickemeier (2009), Furusawa and Konishi (2014), Manasse and Turrini (2001), Monte (2011), and Yeaple (2005) show that firm heterogeneity in production and the resulting exporting behavior create income inequality. Some studies also emphasized the relationship between international trade and income distribution under financial imperfections. Amissah et al. (2011) examine how income distribution affects global trade patterns. Foellmi and Oechslin (2010) show that trade widens income because rich entrepreneurs invest more and benefit more from globalization and poor ones lose due to a resulting increase in the capital rental rate. Ju and Wei (2011) derive impressive results that trade liberalization results in unemployed capitals and reduces labor-abundant countries' aggregate income with poor financial institutions.

Trade liberalization creates a competitive environment influencing economic growth, development, and poverty reduction in case of developing countries (Ben-David et al., 2000; Santarelli & Figini, 2002). Ravallion (2004) establishes that trade liberalization positively affects poverty and income inequality if the effects of trade are pro-poor in developing countries. Krugman and Lawrence (1993) report that trade liberalization creates wage or income inequality in developing countries. Trade liberalization in developing countries, coupled with increased integration of the global economy, attracts inward foreign direct investments (FDI) and creates jobs for skilled workers. The use of foreign technology raises the demand for skilled workers, creating wage inequality between skilled and unskilled workers in the developing countries. This increase in wage inequality is reported in Zhu and Trefler (2005), Dreher et al. (2008), and others. Levine (2012) provides an international comparison across countries on the effects of mobility on income distribution.

3. Methodology and Data Description

3.1. Model Specification and Data

The following general specification has been used in this study to empirically examine the effect of financial

development and technological developments on the economic growth process.

$$LGINI = \alpha_0 + \alpha_1 LPGDP + \alpha_2 LFDI + \alpha_2 LTDI + \alpha_2 LTOP + \alpha_2 LCPI + \varepsilon_t \quad (1)$$

Where LPGDP stands for GDP per capita used as a proxy for economic growth, the LTDI is technological development index; the LFDI represents foreign direct investment as a proxy for financial globalization, LTOP is the trade openness variable which represents the trade globalization variable calculated as (export + imports) / GDP. CPI is the consumer price index taken as the proxy for inflation. The TDI is constructed by using seven major dimensions of technological achievements for India, taking into account resident patents, a number of telephone connections, internet hosts, high technology exports, Gross enrollment ratio, tertiary, both sexes (%), R&D expenditure as a percentage of GDP and Electric power consumption (kWh per capita). The suffix L in the variables denotes that variables are taken in their natural logarithm. The study uses annual data covering the period from 1982 to 2018. The data has been taken and compiled from the Handbook of Statistics on the Indian economy, RBI; Economic Survey, Government of India, World Bank Development Indicators (WDI), and Global Development Finance (GDF) over the period.

3.2. Co-integration with ARDL

To empirically analyze the long-run relationship and dynamic interaction of income inequality with economic growth, trade, financial liberalization, and technological development- the model specified in equation 1 has been estimated by the Auto Regressive Distributed Lag (ARDL) co-integration procedure developed by Pesaran et al. (2001). The procedure is adopted for four reasons. Firstly, the bounds testing is simple as opposed to the multivariate co-integration technique advocated by Johansen and Juselius (1990); it allows a co-integrating relationship to be estimated by OLS once the lag order is selected. Secondly, the bound test procedure does not require the pre-testing of the variables included in the unit root model, unlike other techniques such as Engle and Granger (1987) and Johansen (1992). These approaches require that all the variables to be integrated of the same order (I(1)). However, the ARDL approach is applicable irrespective of whether the variables in the model is I(0) or I(1). The procedure will, however, crash with the inclusion of the I(2) series. Thirdly, the test is more efficient in relatively small sample data sizes, as is this study's case. Fourth the error correction method integrates the short-run dynamics with long-run equilibrium without losing long-run information. The unrestricted error correction model (UECM) of the ARDL model examines the long run &the short-run relationship takes the following form.

$$\begin{aligned}\Delta LGINI_t = {} & \delta_0 + \delta_2 T + \delta_2 LPGDP_{t-1} + \delta_3 LFDI_{t-1} \delta_4 LTDI_{t-1} \\ & + \delta_5 LTOP_{t-1} + \delta_5 LCPI_{t-1} + \sum_{i=1}^{q} \alpha_i \Delta LGINI_{t-i} \\ & + \sum_{i=1}^{q} \gamma_i \Delta LPGDP_{t-i} + \sum_{i=1}^{q} \beta_i \Delta LFDI_{t-i} \\ & + \sum_{i=1}^{q} \mu_i \Delta LTDI_{t-i} \sum_{i=1}^{q} \lambda_i \Delta LTOP_{t-i} \\ & + \sum_{i=1}^{q} \varsigma_i \Delta LCPI_{t-i} + \varepsilon_t \end{aligned} \quad (2)$$

Where the series is as defined earlier and T is time trend, and L implies that the variables have been transformed in natural logs. The first part of the equation (2) with $\delta_1, \delta_2, \delta_3, \delta_4, and\ \delta_5$ refers to the long-run coefficients, and the second part with α , β , μ , λ , γ and ς refers to the short-run coefficients. The null hypothesis of no co-integration $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ and the alternative hypothesis $H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$ implies co-integration among the series (equation 2).

3.3. Bounds Testing Approach

The first step in the ARDL test is to estimate the equation (2) by OLS in order to test for the existence of a long-run relationship among variables by conducting a Wald test (F-statistics) for the joint significance of the coefficients of the lagged levels of variables i.e., H_0 (Null hypothesis) as against H_1(Alternative hypothesis) as stated earlier. Then the calculated F-statistics is compared to the tabulated critical values in Pesaran et al. (2001). If the computed F-values lies below the lower bound critical values, the null hypothesis of no co-integration cannot be rejected. Contrary, if the computed F-statistics exceeds the upper bound, then it can be concluded that the variables are co-integrated. Further, if the calculated F statistics fall in between upper and lower bounds, the inference about a co-integrating relationship is inconclusive. The long-run and short-run dynamic relationship can be estimated on a co-integrating relationship that has been established by the Bounds test.

The long-run co-integrating relationship can be estimated using the following specifications:

$$\Delta LGINI_t = \delta_0 + \delta_1 T + \delta_2 LPGDP_{t-1} + \delta_3 LFDI_{t-1} \delta_4 LTDI_{t-1} + \delta_5 LTOP_{t-1} + \delta_5 LCPI_{t-1} + \varepsilon_t \quad \ldots(3)$$

The third procedure is to obtain the short-run dynamic parameters by estimating an error correction model with the long-run estimates. This is specified as below:

$$\Delta LGINI_t = \sum_{i=1}^{q} \alpha_i \Delta LGINI_{t-i} + \sum_{i=1}^{q} \gamma_i \Delta LPGDP_{t-i} + \sum_{i=1}^{q} \beta_i \Delta LFDI_{t-i} + \sum_{i=1}^{q} \mu_i \Delta LTDI_{t-i} + \phi ECM_{t-1} + \varepsilon_t \quad \ldots(4)$$

Where α, β, μ, λ, γ and ς short-run dynamic coefficient to equilibrium and ϕ is the speed adjustment coefficient.

3.4. Granger Causality Test:

The direction of causality between financial development, technological development, and economic growth is investigated by applying the VECM based granger causality approach after confirming the presence of a co-integrating relationship among the variables in the study. Granger (1969) argued that VECM is more appropriate to examine the causality between the series at I (1). VECM is restricted form of unrestricted VAR, and the restriction is levied on the presence of the long-run relationship between the series. The system of error correction model uses all the series endogenously. This framework allows the predicted values to explain itself both by its own lags and lags of forcing variables as well as the lags of the error correction term and by residual term. The VECM equation is presented as follows:

$$\begin{pmatrix} \Delta LGINI \\ \Delta LPGDP_t \\ \Delta LFDI_t \\ \Delta LTOP_t \\ \Delta LTDI_t \\ \Delta LCPI_t \end{pmatrix} = \begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \end{pmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \beta_{11i} & \beta_{12i} & \beta_{13i} & \beta_{14i} & \beta_{15i} & \beta_{16i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} & \beta_{24i} & \beta_{25i} & \beta_{26i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i} & \beta_{34i} & \beta_{35i} & \beta_{36i} \\ \beta_{41i} & \beta_{42i} & \beta_{43i} & \beta_{44i} & \beta_{45i} & \beta_{46i} \\ \beta_{51i} & \beta_{52i} & \beta_{53i} & \beta_{54i} & \beta_{55i} & \beta_{56i} \\ \beta_{61i} & \beta_{62i} & \beta_{63i} & \beta_{64i} & \beta_{65i} & \beta_{66i} \end{bmatrix} \begin{pmatrix} \Delta LGINI_{t-1} \\ \Delta LPGDP_{t-1} \\ \Delta LFDI_{t-1} \\ \Delta LTOP_{t-1} \\ \Delta LTDI_{t-1} \\ \Delta LCPI_{t-1} \end{pmatrix} + \begin{pmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \\ \gamma_5 \\ \gamma_6 \end{pmatrix} ECM_{t-1} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{pmatrix} \ldots(5)$$

The C's, β's, and γ's are the parameters to be estimated. ECM_{t-1} represents the one period lagged error-term derived from the co-integration vector, and the ε's is serially independent with mean zero and finite covariance matrix. From the Equation (5), given the use of a VAR structure, all variables are treated as endogenous variables. The F test is applied here to examine the direction of any causal relationship between the variables. The LPGDP variable does not Granger cause LGINI in the short run, if and only if all the coefficients of β12i's are not significantly different from zero in Equation (5). These are referred to as the short-run Granger causality test. The coefficients on the ECM represent how fast deviations from the long-run equilibrium is eliminated. Another channel of causality can be studied by testing the significance of ECM's. This test is referred to as the long-run causality test.

4. Results and Discussion

4.1. Unit Root Test Results

Before we proceed with the co-integration test, we test for the macroeconomic series' stationarity properties in the study. The test of stationarity is to ensure that none of the series is integrated at I (2). Thus, to test the stationarity properties of the series, we have used the Ng-Perron unit root test in the present study. The results of the stationarity tests are presented in Table 3. The results show that all the variables are non-stationary at levels. The next step is to differentiate the variables once in order to perform stationary tests on differenced variables. The results show that after differencing the variables once, all the variables were found to be stationary. Therefore, it is worth concluding that all the variables used in this study are integrated of order one, i.e., difference stationary I (1), and none of the variables are I (2). Therefore, the study uses an autoregressive distributed lag (ARDL) approach to co-integration.

5.2. Bounds Test Results

The next process is to apply the bounds testing approach to test the existence of long-run cointegration. Initially, it is noted that when economic growth is selected as a dependent variable, our computed F-statistic (8.0745) turns out to be more than the upper bound at the 1 percent significance level (Table 4). Thus, this implies that there is a long-run co-integrating relationship between income inequality, economic growth, trade, and financial globalization, technology development, and price. This confirms the long-run co-integrating relationship between the variables over the period of 1982-2018 for the Indian economy.

Table 2: Stationarity Test of the Variables: Ng-Perron (2001) unit root test

Variables	MZa	MZt	MSB	MPT
LCPI	0.02491	0.01281	0.5464	19.8618
LFDI	-5.1274	-1.1133	0.2171	5.8193
LGINI	-0.5943	-0.2541	0.4276	14.279
LPGDP	1.02006	0.5724	0.5616	26.5885
LTOP	1.0669	1.2138	1.1376	88.9689
LTDI	-0.0924	-0.0522	0.5647	22.0233
LCPI	-12.7895	-2.4637	0.19264	2.1629
LFDI	-15.9259	-2.8169	0.1769	1.5567
LGINI	-14.1923	-2.6634	0.1876	1.7278
LPGDP	-14.4547	-2.6238	0.1815	1.9364
LTOP	-15.7594	-2.8071	0.1781	1.5547
LTDI	-14.6083	-2.6946	0.18446	1.7073
Critical Values (5%)	-8.10	-1.98	0.233	3.17

Note: L represents the natural logarithm of the variable and Δ denotes the first difference of the series

Table 3: ARDL Bounds test

Panel I: Bounds testing to co-integration:	
Equation: LGINI=F(LPGDP, LFDI, LTOP, LTDI, LCPI)	
Indicators	
Optimal lag	01
F – Statistics	8.0745
Panel II: ARDL model diagnostic tests	
Diagnostic Tests Indicators	
Normality J-B value	0.0954 (0.2540)
Serial Correlation LM Test	0.2201 (0.6614)
Heteroscedasticity Test, (ARCH)	0.8143 (0.5510)
Ramsey Reset Test	1.0041 (0.6020)

Note: Values in the parentheses are probability values

4.3. Cointegration Test Results and Analysis

Table 4 reports the results of the long-run cointegration of the ARDL model. In long-run, we find that, trade globalization reduces income inequality, and it statistically significant at a 5 percent level of significance. This particular relationship proves the implication of the Stolper-Samuelson theorem's prediction that trade will enhance the income of the low-skilled abundant factors of production. Further, it is noted that technological development in India aggravates income inequality India and the coefficient is significant at a 95% level of confidence. This implies that technological development is inherently skill-biased, attributing to reward the factors of production with skilled education. Further, technological development enhances capital intensive production and hence increases the returns to capital owners. Therefore, technological development increases the disparities between capital owners and labour owners and stimulates India's income inequality. Further, the study observed that technology explains income inequality better than trade globalization in India. Apart from the above two variables, the results confirmed a positive and strong association between economic growth and the Gini coefficient. This implies that economic growth in India is not inclusive. It supports the findings that 58% of income is in the hands of only 1% rich. Similarly, inflation contributes positively to the vast disparities of income between rich and poor as the CPI coefficient is positive though not statistically significant. Hence, Overall, it is found that income inequality in India, rising, is contributed partially by economic growth, technological development, and inflation. Whereas trade liberalization, to some extent, helps to reduce the income inequality in India.

Table 4: Income Inequality, Technology, Trade, and Financial Globalization – Results of ARDL Long Run Model

(Dependent variable:LGINI)			
Regressor	**Coefficient**	**t-values**	**Prob.Values**
LTOP	-0.2602**	(-2.4170)	0.023
LTDI	1.5526**	(2.4762)	0.020
LFDI	-0.0002	(-0.0928)	0.927
LPGDP	0.3855***	(2.8569)	0.008
LCPI	0.1306	(1.7288)	0.096
CONS	-2.0728	(-1.2965)	0.206
Robustness Indicators			
R^2		0.8138	
AdjustedR^2		0.7708	
FStatistics		18.9450	
D.W.Stat		1.8548	
Serial Correlation,		F=0.33961	(0.653)
Heteroskedasticity,		F=0.51471	(0.301)
Ramseyr esettest,		F=0.14120	(0.741)

Note: Figures in parentheses are estimated t-values. *, ** and *** indicate significant at 10, 5, and 1 percent level of significance, respectively

Table 5: Income Inequality, Technology, Trade, and Financial Globalization – Results of ARDL Short-Run Model

(Dependentvariable:LGINI)			
Regressor	**Coefficient**	**t-values**	**Prob.Values**
LTOP	-0.2314*	(-1.6879)	0.104
LTDI	1.4481*	(1.6858)	0.105
LFDI	-0.0002	(-0.2606)	0.797
LPGDP	0.2831*	(1.5943)	0.107
LCPI	0.1405	(0.3488)	0.730
CONS	-1.9577	(-0.9406)	0.356
ECMt-1	-0.8354	(-3.7286)	0.001
RobustnessIndicators			
R^2		0.5054	
AdjustedR^2		0.4530	
FStatistics		2.64	
D.W.Stat		1.7548	
Serial Correlation,		F=0.33961	(0.653)
Hetero skedasticity,		F=0.51471	(0.301)
Ramsey resettest,		F=0.14120	(0.741)

Note: (1) figures in parentheses are estimated t-values. *, ** and *** indicate significant at 10, 5, and 1percent level of significance, respectively

Table 5 presents the short-run test statistics of ARDL estimates. In short-run, we also found similar results as reported in the long-run analysis. Here too, technological development has a positive impact, and trade globalization negatively impacts income inequality. Our empirical research shows that technological development and economic growth enhance income inequality in India in the long run and the short-run.

Furthermore, Table 5 also reports that the estimate of the lagged error term, i.e., *ECMt-1,* symbolizes the speed of the adjustment component in equation 4. The estimated result conformed significant and negative error term, which demonstrates that shocks in the short-run is corrected in the long-run. It is found that economic shocks in the short-run are corrected by 80 percent towards the equilibrium path. Hence, the adjustment of recovery takes less than a year in the present model.

Table 6 shows the estimated results of the short- and long-run causality between income inequality, trade, financial globalization, technological development, and economic growth by applying vector error correction model-based (VECM) Granger Causality. Our results confirm that trade globalization, economic growth, financial globalization, and technological development causes income inequality in the long run. The feedback effect is found between income inequality, and its determinant is weak. In short-run, economic growth, trade globalization, inflation, and technological development cause income inequality in India. It is also found that bi-directional causality is present between technological development and economic growth and between economic growth and financial globalization variables. However, there is a presence of unidirectional causality from technological development and inflation towards trade globalization variable. This implies that economic growth is both cause and effect of technological development and financial globalization, which causes income inequality in India.

The robustness of the estimated result is carried out with the use of diagnostic and stability tests. The ARDL-VECM model passes the diagnostic against serial correlation, functional misspecification, and non-normal error. The cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) tests have been used in the present study to investigate the stability of long-run and short-run parameters. The CUSUM and the CUSUMSQ plots are calculated and plotted between critical boundaries at a 5% level of significance. The calculated plots are observed to lie within 5% critical boundaries. Hence, this confirms that models seem to be steady and specified appropriately.

It is pointed out by Pesaran and Shin (2001) that the variable decomposition method shows the contribution in one variable due to innovation shocks stemming in the forcing variables. The variance decomposition indicates the amount of information each variable contributes to the other variables in the auto regression. It determines how much of the forecast error variance of each variable can be explained by exogenous shocks to the other variables. The results of the variance decomposition analysis are reported in Table 7. The estimated figures show that 80.26% of LGINI variations are contributed by its own innovative shocks. Further shock in LPGDP explains income inequality by 5.63%. LFDI contributes to economic growth by 5.27%.

5. Summary and Conclusions

Earlier research stressed the impact of trade and financial globalization on the economy's growth rather than analyzing its effect on the distributional aspects of growth and development. Further, with the growth of unprecedented trade and financial globalization, economies are experiencing technological progress in various fields that might have limited economic growth capabilities by not encouraging them to exploit new avenues created by financial integration. Although technology and globalization are considered as the reasons for unprecedented economic growth in the recent past, what is less clear is their distributional effects on the economy.

Table 6: Granger causality test

Dependent Variables	***Sources of Causation***						
	Short Run (F-Values)						***Long run ECT (t-values)***
	LGINI	**LPGDP**	**LTDI**	**LCPI**	**LTOP**	**LFDI**	
LGINI	---	3.0758**	2.0782*	3.0451**	2.0426*	2.0458*	-3.0434**
LPGDP	0.8158	---	2.0072*	0.2540	0.7152	3.1052**	-0.7392
LTDI	0.8215	2.4380*	---	3.0701**	1.8157	0.7169	-0.5463
LCPI	2.0428*	1.0478	1.0485	---	1.0712	1.1211	-0.9077
LTOP	1.3558	1.0413	2.0579*	3.1604**	---	1.0716	-1.0577
LFDI	0.2582	2.7825**	2.0142	1.0458	1.0742	__--	-0.8078

Notes: * indicate 5 % and ** indicates 10 % level of significance

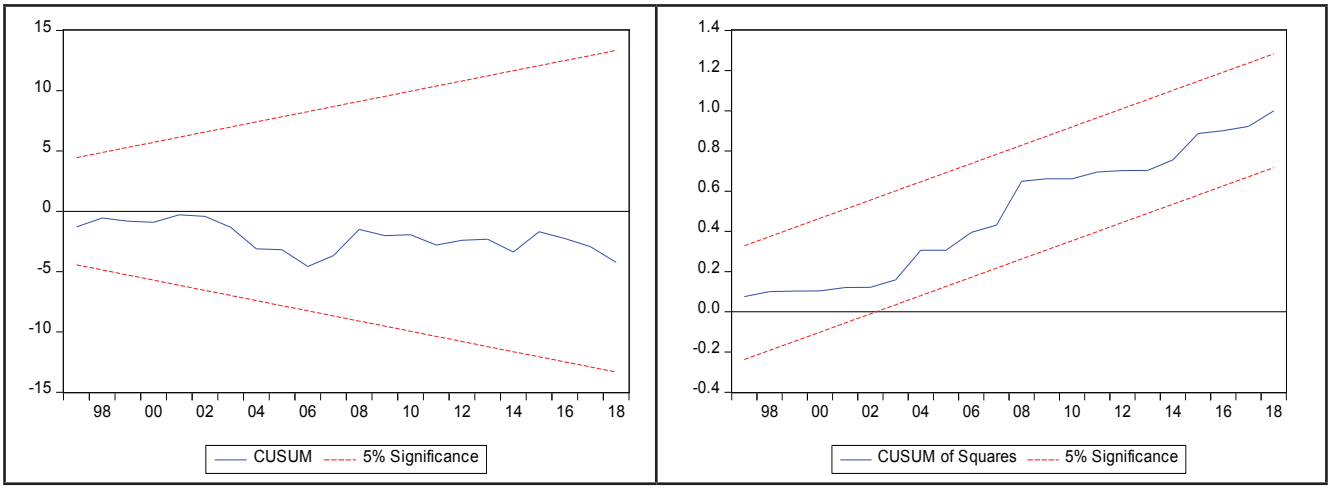

Figure 1: Cusum and Cusum square Stability Test of the Model

Table 7: Variance Decomposition (VDC) Analysis of LGINI

Period	S.E.	LGINI	LPGDP	LTOP	LFDI	LTDI	LCPI
1	0.058537	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.067928	95.63995	0.383501	3.292299	0.226170	0.454024	0.004059
3	0.076032	93.80373	1.189292	3.157957	0.939873	0.368572	0.540576
4	0.088369	92.59055	2.025358	2.338291	0.957009	0.313737	1.775052
5	0.097594	90.47499	2.007945	2.294428	0.813618	1.358603	3.050419
6	0.105452	89.42395	2.313669	2.102684	0.853495	1.888595	3.417605
7	0.116674	86.30745	3.458725	2.082264	1.607517	2.448571	4.095471
8	0.122773	85.68149	4.068534	1.938486	1.570710	2.560091	4.180687
9	0.135213	79.97820	5.125507	2.183608	5.525868	2.804777	4.382038
10	0.139571	80.26747	5.638184	2.049682	5.277581	2.634873	4.132208

In retrospect, keeping in view the above importance of India's relationship and measures taken during the last 30 years, the present study proposes exploring the role of technological development, trade and financial globalization, and economic growth in increasing income inequality of the country. Specifically, the present study suggests to address two research questions, (i) to assess the extent to which does technological innovation, trade, and financial globalization of the Indian economy stimulate income inequality and (ii) to check which factors might promote income inequality and which one might help reducing income inequality. We use time-series data for the Indian economy from 1982 to 2018 to examine the above-mentioned research questions.

We construct an aggregated technological development index (TDI) for India using Principal Component Analysis (PCA) to address these issues. In line with earlier empirical studies, we construct the TDI using seven major dimensions of technological achievements for India, taking into account resident patents, the number of telephone connections, internet hosts, high technology exports, Gross enrolment ratio, tertiary, both sexes (%), R&D expenditure as a percentage of GDP and Electric power consumption (kWh per capita). Apart from using PCA for the construction of TDI, the study used Ng Perron unit root tests for the stationarity testing of the macroeconomic variables, used Auto Regressive Distributed Lag (ARDL) bounds testing approach to test co-integration and VECM based Granger causality test on examining the causal relationship.

The empirical results imply that technological development, trade globalization, financial globalization, economic growth, and income inequality are co-integrated in the long run. The analysis of the evidence of rising income inequality could be largely attributed to the impact of technological change. The contribution of increased globalization has been relatively minor. This reflects two offsetting effects of globalization: while increased trade

globalization tends to reduce income inequality, foreign direct investment tends to exacerbate it. Both financial globalization and technological development tend to increase the demand for education and skills. While incomes of all population segments have increased, but incomes of those who already have higher levels of education and skills have increased disproportionately more. Further, technological development leads to increasing capital intensive production, thereby increasing the returns to capital owners in the economy. Hence, overall, technological development results in an increase in the disparities between capital owners and labour owners and stimulates income inequality in India. Granger causality test results confirm that trade globalization, economic growth, financial globalization, and technological development causes income inequality in India.

In light of the above evidence, we can conclude that an important channel by which globalization and technology development could influence income inequality is through skill development and human development. This research can significantly facilitate stakeholders and policymakers in devising policies towards effective globalization and technological innovation for inclusive growth in the case of India. However, the present paper could be extended along several dimensions. First, it is essential to examine the impact of government policies, in particular on income distribution. While one can imagine that certain types of distribution policies could ameliorate the adverse distribution of income, no comprehensive database is available for such a study. The second line of enquiry could be to examine the impact of FDI in different sectors, where the distributional consequences might be expected to vary. Finally, the impact of technological development may vary for different sectors and types of technology used. This is also too limited by the availability of comprehensive data presently.

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