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TRADE LIBERALIZATION AND FISCAL STANCE IN SELECTED DEVELOPING COUNTRIES: A GRANGER CAUSALITY APPROACH IN VAR FRAMEWORK

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ABSTRACT
The main purpose of the study is to conduct a causality analysis of trade liberalization and fiscal stance. For this purpose, causality between tax-trade, government expenditures-trade, external debt-trade and official development assistance-trade have been examined in selected developing countries. The study has applied the three-step procedure of Granger causality in the VAR framework. The period is taken from 1996 to 2019. The results show that there is bidirectional causality between trade liberalization and fiscal stance in nearly all countries while short-run causality differs in the group of countries. The study suggests that the policymakers may formulate policies of trade openness which may enhance the tax revenues as well as government expenditures in developing countries.

Keywords: Trade liberalization, Tax, Government Expenditures, External Debt
JEL Codes: B17, H20, H30

I. INTRODUCTION
Trade liberalization is considered the reduction in barriers to the movement of goods and services in international trade. Trade liberalization has become the main part of economic policies because world trade has highly increased in the previous fifty years based on the reduction in trade barriers by multilateral negotiations (McCulloch et al., 2001). Trade liberalization has a positive relation with economic growth (Longoni, 2009). Trade liberalization carries outstanding benefits which lead to induce many countries to take the way of free trade policy. Trade liberalization is related to the removal of taxes also tariffs, import duties and other limitations on trade like import quotas, subsidies and non-tariff trade barriers. The degree of openness measured by international trade's share in GDP may have a significant influence on tax revenues in developing countries. Shares of imports, as well as exports, can also be important for tax revenues (Karagoz, 2013). Public expenditures have been reduced because of the revenue crisis in many developing countries. So, the fiscal adjustment is possible due to a fall in expenditures, rather than enhancing the tax revenues (Hicks, 1988; Edwards, 1996). There is a positive association between government spending and trade liberalization. The argument is that the disclosure of external risk (the consequence of more openness) has put more pressure on the government to minimize the risk through the provision of social insurance (Rodrik, 1997). Trade liberalization shows a mixed influence on tax revenues and government expenditures as a positive impact leading to enhance revenues and expenditures and vice versa. The association between trade liberalization and debt seems not to be more straightforward as compared to other variables. The interlinking between trade openness and debt contains opposite parts of one coin. The shining side displays a snap of inverse association of external debt and measures of trade openness, any type of economic openness would lead to a fall in external debt (Zafar et al., 2008). In turn, the dark portion of the coin displays a positive link between external debt and policy of trade liberalization specifically for developing economies, trade openness needs depletion or removal of tariffs on imports and also exports, and as result, the fiscal gap can be filled up by borrowing (Caliari, 2005; Ali and Naeem, 2017; Ali, 2011; Ali, 2015; Ali, 2018; Ali and Bibi, 2017; Ali and Ahmad, 2014; Ali and Audi, 2016; Ali and Audi, 2018; Ali and Rehman, 2015; Ali and Senturk, 2019; Ali and Zulfiqar, 2018; Ali et al., 2016; Ali et al., 2021; Ali et al., 2021; Ali et al., 2015; Arshad and Ali, 2016; Ashraf and Ali, 2018; Audi et al., 2022).

Benefits from trade generally stem from rising income for local consumers, and also industrial customers for inputs that are imported. Trade openness can possess a positive effect on servicing of debt and external debt, as this brings a rise

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in growth at the domestic level, and also a rise in exports and productivity. The level of trade liberalization possesses a positive influence on the structure of debt of countries through fascinating foreign direct investment and foreign exchange reserves (Lane and Ferretti, 2000). Governments of developing economies depend heavily upon the revenue of trade tax. So, trade openness can be one of the possible ways of notable fiscal uncertainty and may have an impact on government expenditure on development ventures (Audi and Ali, 2017; Audi and Ali, 2017; Audi et al., 2021; Audi and Ali, 2016; Audi et al., 2021; Audi et al., 2021; Audi et al., 2021; Haider and Ali, 2015; Kaseem et al., 2019; Roussel et al., 2021; Senturk and Ali, 2021; Mehmood et al., 2022). Foreign aid is considered an alternative to the loss of revenues attached to trade liberalization. Bilateral donor economies give heavily aid to compensate for liberalizing recipient economies which face a reduction in trade tax revenues. This is not true for multilateral economies. Multilateral donors are more focused on income per capita (Younas and Bandyopadhyay, 2007). The remaining paper consists of the following sections: Section 2 exhibits the review of the literature. Section 3 portrays model specifications. Section 4 explains results and discussions and section 5 concludes the paper.

II. REVIEW OF LITERATURE

In the scenario of trade liberalization and tax revenues, Khattry and Rao (2002) investigated the negative relationship between trade openness and tax revenues in developing economies. Epko (2003) assessed the effects of trade openness on the revenue of governments in Africa and found that the ratio of imports to GDP had increased the trade to GDP ratio. Agbeyegbe et al. (2004) exhibited that trade liberalization was not strongly connected to aggregate tax revenues. Baunsgaard and Keen (2005) explored that in low-income countries tax revenues were very small concerning trade liberalization. Agbeyegbe et al. (2006) tested that trade openness had no strong link with aggregate tax revenues or its parts. Egwakhe et al. (2018) explored the negative significant impacts of trade openness on tax revenue in Nigeria. Suvannaphakdy and Toyoda (2019) evaluated that more coordinated tariff and reform of tax had meant less revenue for the government by fall of the blend of the rate of indirect tax and tariff. Loganathan et al. (2020) sorted out that trade liberalization had no significant causality effect on the collection of tax whereas economic performance and fiscal development had an opposing impact on the collection of tax for a long period in Malaysia.

In the relationship between trade liberalization and government spending, Khattry (2003) evaluated that trade liberalization had declined revenues and increased interest expenditures. Abizadeh (2005) examined that as small economies improved trade openness, government expenditures declined. Kueh et al. (2009) explored that trade liberalization had a positive and significant relationship with government expenditures in selected economies. Ram (2009) projected no positive association between openness and government size because of arbitrating role of country size. Liberati (2013) analyzed the negative significant impacts of capital openness on government expenditures. Amin and Murshed (2016) analyzed unidirectional causality between trade openness and government size. Farhad and Jetter (2019) explained that there was a positive relationship between trade liberalization and government size. Maluleke (2020) examined unidirectional causation within trade liberalization, government spending and economic growth. From the perspective of trade liberalization and debt, Zafar and Butt (2008) analyzed a significant positive link between free trade and the debt burden. Zakariya (2012) explored positive impacts in terms of trade, fiscal deficit, and inflation on the foreign debt. Kizilgol and Ipek (2014) assessed that free trade had positively raised external debt. Awan et al. (2015) sorted out that trade openness increased the debt burden. Bolukbas (2016) found that the link between trade liberalization and international debt was positive as well as significant. So, the relationship between trade liberalization, tax revenues, government spending and debt has mixed results.

III. MODEL SPECIFICATION

In this analysis, Granger's theorem has been applied. The specification of VAR has become highly famous in the literature on applied econometrics, its basic benefit being that such models have the specifications of dynamics, and economic assumptions free imposed a priori (Georgiou et al, 1996). The approach that has been adopted to analyze the causality of trade liberalization and fiscal stance within the framework of VAR, begins off by examining the properties of integration of two series. If two series have integrated of the same order i.e. both are I (1), the Granger causality must prevail in at least one direction, at least in I(0) variables (Engle and Granger, 1987). Granger's theorem explains how to model a cointegrated I(1) series in form of the VAR model. To capture the dynamics of the short run, the VAR can be developed in terms of the level of the data or the first difference within the Error Correction Term (ECT). Following are the various models of trade liberalization and fiscal stance:

Model 1: Tax-Trade Causality Model

$$TAX_t = \sum_{i=1}^{k} \alpha_i TRADE_{t-i} + \sum_{j=1}^{k} \beta_j TAX_{t-j} + \varepsilon_{1t}$$

$$TRADE_t = \sum_{i=1}^{n} \gamma_i TRADE_{t-i} + \sum_{j=1}^{n} \delta_j TAX_{t-j} + \varepsilon_{2t}$$

Model 2: Government Expenditures-Trade Causality Model

$$GE_t = \sum_{i=1}^{k} \alpha_i TRADE_{t-i} + \sum_{j=1}^{k} \beta_j GE_{t-j} + \varepsilon_{1t}$$

$$TRADE_t = \sum_{i=1}^{n} \gamma_i TRADE_{t-i} + \sum_{j=1}^{n} \delta_j GE_{t-j} + \varepsilon_{2t}$$

Model 3: External Debt-Trade Causality Model

$$ED_t = \sum_{i=1}^{k} \alpha_i TRADE_{t-i} + \sum_{j=1}^{k} \beta_j ED_{t-j} + \varepsilon_{1t}$$

$$TRADE_t = \sum_{i=1}^{n} \gamma_i TRADE_{t-i} + \sum_{j=1}^{n} \delta_j ED_{t-j} + \varepsilon_{2t}$$

Model 4: ODA-Trade Causality Model

$$ODA_t = \sum_{i=1}^{k} \alpha_i TRADE_{t-i} + \sum_{j=1}^{k} \beta_j ODA_{t-j} + \varepsilon_{1t}$$

$$TRADE_t = \sum_{i=1}^{n} \gamma_i TRADE_{t-i} + \sum_{j=1}^{n} \delta_j ODA_{t-j} + \varepsilon_{2t}$$

IV. RESULTS AND DISCUSSIONS

This section explains the results of long-run causality as well as short-run causality among models tax-trade, trade-tax models, GE-trade, trade-GE models, ED-trade and trade-ED and ODA-trade and trade-ODA models based on three steps. In the end, we will elaborate on whether the causality is unidirectional, bidirectional or there is no causality among the variables.

IV.I. TESTING FOR UNIT ROOTS

The first step for applying the Granger causality is to investigate the properties of integration by employing the tests of Dickey-Fuller's (1979) unit root tests. The test has based on the intercept, intercept and trend and none equations. Tables 1, 2, 3 and 4 indicate the unit root test results for LIC, LMIC, LMIC and all the developing countries. The results exhibit that all the variables are integrated of order 1 i.e. I(1). Therefore, we have applied the Vector error correction model (VECM) to test the cointegration in all the models.

IV.II. TESTING FOR COINTEGRATION

It is crucial to establish the properties of integration to justify further analysis of cointegration. If both the series have integrated of the same order i.e. I(1), there might prevail a long-run relationship between them. For testing the cointegration (the existence of a long-run relationship), we have applied panel cointegration tests. There are three tests "Kao residual test, the Johansen fisher panel and the Pedroni test". Although cointegration can be tested by one test only yet we have applied all these tests to investigate their robustness among them. Table 5 consists of the results of the Kao residual cointegration tests for the tax trade model for all types of countries (low income, low-middle income, upper-middle-income and all the developing countries).

Table 1: Unit Roots Tests Results for Low-Income Countries

Unit Root Test on Level												
Variable	Intercept				Intercept and Trend				None			Result
	LLC Test	IPS Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	LLC Test	IPS Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	LLC Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	
ED	-1.2867 (0.0991)	0.63143 (0.7361)	26.0026 (0.8354)	33.1398 (0.5096)	-0.5957 (0.2757)	0.6151 (0.7308)	30.3526 (0.6471)	40.9895 (0.1907)	-0.0963 (0.4616)	60.4795 (0.2322)	65.0345 (0.4128)	I(1)
GE	-4.9142 (0.2000)	-2.1130 (0.2173)	68.1803 (0.4065)	97.3208 (0.4040)	-1.1674 (0.3151)	-0.8677 (0.1928)	53.0480 (0.1180)	49.4103 (0.2013)	-0.9753 (0.1647)	38.1578 (0.6403)	94.8888 (0.5200)	I(1)
ODA	-1,8480 (0.2323)	-1.2413 (0.1172)	53.2620 (0.1782)	88.7792 (0.2202)	-1.5888 (0.1560)	-0.9889 (0.1614)	45.9586 (0.2390)	85.7967 (0.2589)	-0.6295 (0.2645)	58.5133 (0.1466)	94.2767 (0.7892)	I(1)
TAX	-1.0783 (0.1404)	-0.8896 (0.1868)	45.2353 (0.0943)	43.7748 (0.1216)	-11.303 (0.1475)	-10.268 (0.4865)	332.762 (0.1478)	323.538 (0.1492)	-0.6286 (0.2648)	21.8333 (0.9957)	20.4300 (0.9980)	I(1)

Table 2: Unit Roots Tests Results for Lower Middle-Income Countries

Unit Root Test on Level												
Variable	Intercept				Intercept and Trend				None			Result
	LLC Test	IPS Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	LLC Test	IPS Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	LLC Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	
ED	-7.5733 (0.4785)	-4.3628 (0.4769)	183.386 (0.1586)	181.317 (0.2358)	-6.4092 (0.3258)	-0.4893 (0.3123)	308.723 (0.9852)	309.660 (0.0925)	-4.9381 (0.0865)	150.390 (0.1258)	156.149 (0.2586)	I(1)
GE	-4.2564 (0.8750)	-2.9169 (0.1098)	128.041 (0.5785)	155.665 (0.3258)	-3.5440 (0.2856)	-1.7819 (0.0374)	101.932 (0.4469)	158.881 (0.4782)	0.5924 (0.7232)	63.0305 (0.6478)	59.3829 (0.7626)	I(1)
ODA	-5.9027 (0.1453)	-4.7512 (0.2589)	131.732 (0.6856)	133.666 (0.3987)	-7.5412 (0.1589)	-7.0868 (0.1258)	169.552 (0.1258)	172.744 (0.2114)	-7.4500 (0.1425)	153.994 (0.3332)	175.510 (0.0987)	I(1)
TAX	0.2572 (0.6015)	-3.2140 (0.7985)	115.471 (0.2596)	117.908 (0.2352)	-3.2726 (0.2255)	-2.8437 (0.2322)	98.0345 (0.6455)	108.033 (0.2258)	30.0867 (1.0000)	54.5166 (0.8819)	54.4455 (0.8833)	I(1)
TRADE	-1.8190 (0.0345)	-1.1424 (0.1266)	79.8555 (0.1540)	80.6701 (0.1397)	-0.0487 (0.4805)	1.2793 (0.8996)	61.1582 (0.7088)	60.6339 (0.7252)	0.0505 (0.5202)	49.1917 (0.9584)	49.3615 (0.9568)	I(1)

Table 3: Unit Roots Tests Results for Upper Middle-Income Countries

Unit Root Test on Level												
Variable	Intercept				Intercept and Trend				None			Result
	LLC Test	IPS Test	ADF-Fisher	PP-Fisher	LLC Test	IPS Test	ADF-Fisher	PP-Fisher	LLC Test	ADF-Fisher	PP-Fisher	
ED	-6.9473 (0.2259)	-3.4430 (0.2589)	112.443 (0.2545)	99.3813 (0.1541)	-6.7055 (0.1158)	-2.0788 (0.1888)	157.303 (0.2596)	103.734 (0.2163)	-2.8815 (0.1020)	78.8795 (0.6032)	79.1086 (0.2231)	I(1)
GE	0.3643 (0.6422)	-1.7411 (0.8408)	78.7343 (0.1534)	74.2744 (0.5589)	-2.6344 (0.5642)	-1.3360 (0.1908)	67.0199 (0.1231)	66.5912 (0.2351)	291.917 (1.0000)	23.9634 (0.9986)	37.7895 (0.8549)	I(1)
ODA	0.0614 (0.5245)	-5.2206 (0.9876)	118.679 (0.3258)	158.945 (0.2258)	-8.0165 (0.1147)	-5.9057 (0.1580)	104.478 (0.0985)	119.583 (0.2582)	22.3483 (1.0000)	126.742 (0.1935)	149.377 (0.8540)	I(1)
TAX	-3.0217 (0.1413)	-3.5180 (0.2583)	96.5955 (0.1478)	93.1414 (0.1471)	-2.7025 (0.4934)	-2.6302 (0.1443)	81.7589 (0.0017)	78.9360 (0.4832)	1.1440 (0.8737)	28.6806 (0.9879)	31.1742 (0.9714)	I(1)
TRADE	-2.8650 (0.2125)	-2.3594 (0.9214)	72.1875 (0.0135)	82.7251 (0.1914)	-2.3593 (0.0092)	-1.0290 (0.1517)	54.9993 (0.2267)	59.8537 (0.1172)	0.3423 (0.6340)	24.2753 (0.9983)	23.3660 (0.9990)	I(1)

Table 4: Unit Roots Tests Results for All Developing Countries

Unit Root Test on Level												
Variable	Intercept				Intercept and Trend				None			Result
	LLC Test	IPS Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	LLC Test	IPS Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	LLC Test	ADF-Fisher Chi Square	PP-Fisher Chi Square	
ED	0.1918 (0.5761)	-3.8402 (0.1591)	331.195 (0.1225)	316.996 (0.9966)	-9.9462 (0.1147)	-1.4132 (0.0788)	504.059 (0.9852)	454.384 (0.2253)	49.4917 (1.0000)	289.452 (0.0000)	302.714 (0.5200)	I(1)
GE	0.3600 (0.6406)	-4.5713 (0.2589)	303.232 (0.1211)	329.692 (0.2583)	-2.6519 (0.4011)	-0.9237 (0.1778)	206.372 (0.5822)	276.945 (0.1147)	267.947 (1.0000)	210.382 (0.2583)	192.189 (0.0420)	I(1)
ODA	0.6929 (0.7558)	-7.3359 (0.1212)	329.450 (0.3369)	384.285 (0.1597)	-11.982 (0.3336)	-9.3998 (0.9666)	345.144 (0.5585)	380.718 (0.3252)	19.8317 (0.5800)	396.550 (0.2223)	424.628 (0.2580)	I(1)
TAX	-0.1418 (0.4436)	-3.5778 (0.1158)	259.277 (0.2959)	260.031 (0.1114)	-7.1348 (0.2221)	-6.1790 (0.2532)	330.274 (0.2259)	511.688 (0.2200)	133.806 (1.0000)	104.410 (0.9999)	106.687 (0.9998)	I(1)
TRADE	1.7481 (0.9598)	-3.3318 (0.1478)	249.386 (0.4477)	259.137 (0.2987)	-2.4348 (0.7414)	-1.6218 (0.1524)	204.519 (0.3353)	208.173 (0.6252)	10.5189 (1.0000)	162.875 (0.4219)	165.167 (0.3734)	I(1)

Table 5: Kao Residual Cointegration Tests for Tax-Trade Model

Countries	ADF t-Stat.	ADF Prob.
Low Income Countries	-1.89	0.0289
Low Middle-Income Countries	-2.92	0.0017
Upper Middle-Income Countries	-3.95	0.0000
All Developing Countries	-2.79	0.0026

The probability values show that there exists a cointegration (long-run relationship) in the tax-trade model in all types of countries. The next step is to examine the cointegration based on the Johnsen Fisher panel cointegration test. It has been divided into two tests one is the Trace test another is the Max-Eigen test. For low income, lower middle income, upper middle income and all countries, both the test statistics show that there exists a long-run relationship.

Table 6: Johansen Fisher Panel Cointegration Test for Tax-Trade Model

Countries	Hypothesized No. of CE(s)	Fisher Stat. (Trace test)	Prob.	Fisher Stat. (Max-Eigen test)	Prob.
Low Income Countries	None	117.9	0.0000	101.1	0.0000
	At most 1	73.45	0.0001	73.45	0.0001
Low Middle Income Countries	None	182.4	0.0000	137.7	0.0000
	At most 1	160.9	0.0000	160.9	0.0000
Upper Middle Income Countries	None	106.2	0.0000	77.51	0.0044
	At most 1	109.3	0.0000	109.3	0.0000
All Developing Countries	None	409.7	0.0000	318.2	0.0000
	At most 1	349.1	0.0000	349.1	0.0000

Table 7 demonstrates the results of the Pedroni residual cointegration test. It indicates the probabilities values of the alternative hypothesis. In LIC out of eleven values of probability eight values come within a range of 0.00-0.10 indicating the existence of cointegration in the tax-trade model in these countries.

In the case of LMIC, nine values out of eleven show the existence of cointegration. due to having the probabilities values within the range of 0.00-0.10. In the case of UMIC, eight values have probability values within the range of 0.00-0.10 indicating the existence of cointegration in the tax-trade model in these countries. Similar to LMIC, in all the developing countries among eleven values of probability eight values come within the range of 0.00-0.10 exhibiting the existence of cointegration in the tax-trade model in these countries.

IV.III. GRANGER CAUSALITY TESTS

The next step is based on the application of the Granger causality tests augmented within a proper term of error correction that has been taken out from a long period of association of cointegration. To find out the long run and short-run causality, we have applied Residual VAR i.e., Vector Error Correction Model (VECM) because when we have examined stationarity through unit root tests, our results of the tax-trade model are found stationary at the first difference for all the countries hence, we have applied VECM to find long-run and short-run causality. In Table 8, we have used Error Correction Term (ECT) to examine the long-run causality for low-income countries.

The upper part of Table 8 indicates the existence of causality within trade and tax in the long period. ECT is negative as well as significant which shows running of causality in long term from independent towards dependent variable. The lower part of Table 8 indicates the long-run causality between tax and trade. ECT is also negative and significant indicating the long-run causality between tax and trade. The causality is bidirectional for both the tax-trade model and the trade-tax model. For investigating short term causation between tax trade and trade tax model for low-income countries, we applied the Wald test in Table 9.

Order C(2) and C(3) display the short-run causality of tax to tax while C(4) and C(5) represent the short-run causality of trade towards tax. On the other side, C(8) and C(9) indicate the short-run causality of trade to trade and C(10) and C(11) exhibit the short-run causality of tax to trade. The probability value of tax to tax is 0.47 indicating that there exists no short-run causality between them. Trade to tax has the probability value of 0.51 showing that there is no short-run causality between them. The probability values of trade to trade and tax to trade are 0.00 and 0.03 respectively exhibiting that there exists short-run causality between them. The short-run causality in the tax-trade model is unidirectional and in the trade tax model, there is also a unidirectional short-run causality. In Table 10, we applied ECT to examine long period causality for LMIC. The upper part of Table 10 explores Long-run causality among trade-tax.

Table 7: Pedroni Residual Cointegration Tests for Tax-Trade Model

Countries	Alternative Hypothesis	Stat.	Prob.	Weighted Stat.	Prob.
Low Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	1.591	0.0558	-0.953	0.8300
	Panel rho-Stat.	-1.736	0.0413	-0.802	0.2112
	Panel PP-Stat.	-2.302	0.0107	-1.851	0.0321
	Panel ADF-Stat.	-3.044	0.0012	-2.212	0.0135
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-1.084	0.1392		
	Group PP-Stat.	-3.279	0.0005		
	Group ADF-Stat.	-3.426	0.0003		
Lower Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	2.382	0.0086	0.729	0.2329
	Panel rho-Stat.	-2.109	0.0174	-0.934	0.1749
	Panel PP-Stat.	-3.520	0.0002	-2.548	0.0054
	Panel ADF-Stat.	-3.7500	0.0001	-3.228	0.0006
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-0.7109	0.2386		
	Group PP-Stat.	-3.804	0.0001		
	Group ADF-Stat.	-4.989	0.0000		
Upper Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	1.930	0.0268	0.662	0.2539
	Panel rho-Stat.	-3.049	0.0011	-0.925	0.1773
	Panel PP-Stat.	-4.312	0.0000	-2.075	0.0190
	Panel ADF-Stat.	-3.274	0.0005	-1.724053	0.0423
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-1.206	0.1138		
	Group PP-Stat.	-3.197	0.0007		
	Group ADF-Stat.	-3.215	0.0007		
All Developing Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	3.448	0.0003	0.156526	0.4378
	Panel rho-Stat.	-3.766	0.0001	-1.520040	0.0643
	Panel PP-Stat.	-5.656	0.0000	-3.720622	0.0001
	Panel ADF-Stat.	-5.790	0.0000	-4.139664	0.0000
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-1.614	0.0532		
	Group PP-Stat.	-5.862	0.0000		
	Group ADF-Stat.	-6.719	0.0000		

Table 8: Long run Causality for Tax-Trade Model (Low-Income Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
Tax-Trade Model: DV=D(Tax)					
C(1)	ECT	-0.072626	0.021223	-3.422100	0.0007
C(2)	D(TAX(-1)	-0.058160	0.047347	-1.228368	0.2196
C(3)	D(TAX(-2)	-0.007060	0.046482	-0.151888	0.8793
C(4)	D(TRADE(-1)	-0.011108	0.010124	-1.097180	0.2729
C(5)	D(TRADE(-2)	0.000899	0.009972	0.090104	0.9282
C(6)	CONSTANT	0.099500	0.108679	0.915544	0.3602
R^2 = 0.041240			DW stat = 2.039916		
Trade-Tax Model: DV=D(Trade)					

C(7)	ECT	-0.018455	0.008323	-2.217283	0.0271
C(8)	D(TRADE(-1)	-0.191047	0.044316	-4.311032	0.0000
C(9)	D(TRADE(-2)	-0.114097	0.043642	-2.614362	0.0093
C(10)	D(TAX(-1)	-0.271893	0.207232	-1.312022	0.1902
C(11)	D(TAX(-2)	-0.501667	0.203435	-2.465977	0.0141
C(12)	CONSTANT	0.142604	0.474722	0.300395	0.7640
$R^2 = 0.070707$			DW stat = 1.976201		

Table 9: Short-run Causality based on Wald Test Results for Tax-Trade Model (Low-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(TAX(-1) = D(TAX(-2) = 0	C(2)=C(3)=0	0.75	0.47
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	0.66	0.51
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	10.72	0.00
D(TAX(-1) = D(TAX(-2) = 0	C(10)= C(11)=0	3.45	0.03

Table 10: Long run Causality for Tax-Trade Model (Lower-Middle-Income Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
Tax-Trade Model: DV=D(Tax)					
C(1)	ECT	-0.061598	0.014912	-4.130858	0.0000
C(2)	D(TAX(-1)	-0.010407	0.037398	-0.278269	0.7808
C(3)	D(TAX(-2)	-0.015357	0.036110	-0.425276	0.6707
C(4)	D(TRADE(-1)	0.012205	0.007734	1.578145	0.1148
C(5)	D(TRADE(-2)	-0.000977	0.007643	-0.127823	0.8983
C(6)	CONSTANT	0.054703	0.079413	0.688848	0.4910
$R^2 = 0.031$			DW stat = 2.00		
Trade-Tax Model: DV=D(Trade)					
C(7)	ECT	-0.127737	0.072556	-1.760523	0.0785
C(8)	D(TRADE(-1)	-0.080416	0.181970	-0.441918	0.6586
C(9)	D(TRADE(-2)	-0.042587	0.175702	-0.242383	0.8085
C(10)	D(TAX(-1)	-0.004493	0.037632	-0.119387	0.9050
C(11)	D(TAX(-2)	-0.047404	0.037189	-1.274695	0.2026
C(12)	CONSTANT	-0.108040	0.386402	-0.279606	0.7798
$R^2 = 0.008$			DW stat = 2.03		

ECT is negative as well as significant which is showing Long-run causality existing from independent towards dependent variable. The lower part of Table 10 indicates the Long-run causality between tax and trade. ECT is as well as negative and significant indicates the Long-run causality within the tax-trade. Causation is bidirectional for both the tax trade model and the trade tax model. For exploring the Short-run causality between tax trade and the trade tax model, we have applied the Wald test in Table 11.

Table 11: Short-run Causality based on Wald Test Results for Tax-Trade Model (Lower Middle-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(TAX(-1) = D(TAX(-2) = 0	C(2)=C(3)=0	0.23	0.88
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.25	0.28
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	0.11	0.88
D(TAX(-1) = D(TAX(-2) = 0	C(10)= C(11)=0	0.81	0.44

In LMIC, there is no Short-run causality from tax to tax because its probability value is 0.88. Similarly, between trade to tax, trade to trade and tax to trade there is no S.R causality. It means the absence of Short-run causality in tax trade as well as the trade tax model in LMIC. In Table 12, we have used the error correction term for checking long-run causality for UMIC. The upper part of Table 12 indicates long-run causality within trade and tax. ECT is negative and significant showing Long-run causality running from independent to the dependent variable.

The lower part of Table 12 indicates the long-run causality between tax and trade. ECT is also negative and significant representing long-run causality among tax and trade. Causation is bidirectional for both the tax trade model and the trade tax model. For checking the Short-run causality between tax trade and the trade tax model for upper-middle-income countries we have applied the Wald test in Table 13.

Table 12: Long run Causality for Tax-Trade Model (UMIC)

		Coefficient	Std. Error	t-Stat.	Prob.
Tax-Trade Model: DV=D(Tax)					
C(1)	ECT	-0.042137	0.013223	-3.186620	0.0015
C(2)	D(TAX(-1)	-0.049733	0.044050	-1.129018	0.2594
C(3)	D(TAX(-2)	-0.072170	0.039036	-1.848812	0.0651
C(4)	D(TRADE(-1)	0.018023	0.009465	1.904208	0.0575
C(5)	D(TRADE(-2)	-0.000927	0.009259	-0.100112	0.9203
C(6)	CONSTANT	-0.028575	0.072880	-0.392080	0.6952
R^2 = 0.04			DW stat = 1.97		
Trade-Tax Model: DV=D(Trade)					
C(7)	ECT	-0.018261	0.008204	-2.225888	0.0265
C(8)	D(TRADE(-1)	-0.070660	0.043460	-1.625874	0.1046
C(9)	D(TRADE(-2)	-0.139158	0.042513	-3.273261	0.0011
C(10)	D(TAX(-1)	0.307208	0.202268	1.518815	0.1294
C(11)	D(TAX(-2)	-0.352263	0.179244	-1.965272	0.0499
C(12)	CONSTANT	0.424123	0.334648	1.267370	0.2056
R^2 = 0.05			DW stat = 2.00		

Table 13: Short-run Causality based on Wald Test Results for Tax-Trade Model (Upper Middle-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(TAX(-1) = D(TAX(-2) = 0	C(2)=C(3)=0	2.19	0.11
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.84	0.15
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	6.27	0.00
D(TAX(-1) = D(TAX(-2) = 0	C(10)= C(11)=0	3.34	0.03

Order C(2) and C(3) are representing the Short-run causality of tax to tax while C(4) and C(5) are representing the Short-run causality of trade to tax. While C(8) and C(9) are indicative of the Short-run causality of trade to trade and C(10) and C(11) denote the Short-run causality of tax to trade. The probability value of tax to tax is 0.11 indicating no Short-run causality between them. Trade to tax has the probability value of 0.15 also showing the presence of no Short-run causality between them. The probabilities values of trade to trade and tax to trade are 0.00 and 0.03 respectively showing that there exists Short-run causality among them. Short period causation in the tax trade model is unidirectional and in the trade tax model is as well as unidirectional SR causation.

Table 14: Long run Causality for Tax-Trade Model (All Developing Countries)

		Coefficient	S.E	t-Stat.	Prob.
Tax-Trade Model: DV=D(Tax)					
C(1)	ECT	-0.059753	0.009373	-6.374730	0.0000
C(2)	D(TAX(-1)	-0.034374	0.024100	-1.426284	0.1540
C(3)	D(TAX(-2)	-0.025062	0.023028	-1.088334	0.2766
C(4)	D(TRADE(-1)	0.004160	0.005026	0.827698	0.4080
C(5)	D(TRADE(-2)	-0.000407	0.004947	-0.082206	0.9345
C(6)	CONSTANT	0.048624	0.049392	0.984450	0.3250
R^2 = 0.03			DW stat = 2.00		
Trade-Tax Model: DV=D(Trade)					
C(7)	ECT	-0.002203	0.002505	-0.879351	0.3793
C(8)	D(TRADE(-1)	-0.075836	0.023865	-3.177705	0.0015
C(9)	D(TRADE(-2)	-0.077335	0.023488	-3.292475	0.0010
C(10)	D(TAX(-1)	-0.067060	0.114435	-0.586006	0.5580
C(11)	D(TAX(-2)	-0.266181	0.109342	-2.434386	0.0150
C(12)	CONSTANT	0.074783	0.234405	0.319033	0.7497
R^2 = 0.15			DW stat = 2.00		

In Table 14, we have again used ECT for checking long-run causality for all developing countries. The upper part of Table 14 indicates the Long-run causality between trade and tax. ECT is negative as well as significant which shows the presence of Long-run causality from independent to dependent variable. The lower part of Table 14 indicates no long-run causality between tax and trade. ECT is negative but insignificant indicating no long-run causality between tax and trade. Causation is unidirectional from trade to tax.

To examine the short-run causality between tax trade and the trade tax model for all developing countries, we have applied the Wald test in Table 15. Order C(2) and C(3) are representing the Short-run causality of tax to tax while C(4) and C(5) represent the Short-run causality of trade-tax. C(8) and C (9) illustrate the Short-run causality of trade to trade and C(10) and C(11) show the Short-run causality of tax-trade.

Table 15: Short-run Causality based on Wald Test Results for Tax-Trade Model (All Developing Countries)

Null Hypothesis		F-Stat.	Prob.
D(TAX(-1) = D(TAX(-2) = 0	C(2)=C(3)=0	1.45	0.23
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	0.35	0.70
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	3.01	0.04
D(TAX(-1) = D(TAX(-2) = 0	C(10)= C(11)=0	9.56	0.00

The probability value of tax to tax is 0.23 indicating no Short-run causality between them. Trade-tax has the prob value of 0.70 also showing the presence of no Short-run causality between them. The probabilities of trade to trade and tax to trade are 0.04 and 0.00 respectively showing that there exists short-run causality among them. Short period causality in the tax trade model is unidirectional and in the trade tax model as well as the presence of unidirectional SR causation. Table 16 consists of conclusions of Kao residual cointegration for the GE-trade model for all the countries (LIC, LMIC, UMIC, and all developing countries).

Table 16: Kao Residual Cointegration Tests for Government Expenditures-Trade Model

Countries	ADF t-Stat.	ADF Prob.
Low Income Countries	-1.19	0.11
Low Middle-Income Countries	4.51	0.00
Upper Middle-Income Countries	-3.11	0.00
All Developing Countries	5.30	0.00

Probability values show the existence of cointegration (Long-run relationship) in the GE-trade model within all countries. The second test to check the cointegration is the Johnsen Fisher panel cointegration test. It has been divided into two tests one is the Trace test another is the Max-Eigen test.

Table 17: Johansen Fisher Panel Cointegration Test for Government Expenditures-Trade Model

Countries	Hypothesized No. of CE(s)	Fisher Stat. (Trace test)	Prob.	Fisher Stat. (Max-Eigen test)	Prob.
Low Income Countries	None	150.2	0.0000	114.5	0.0000
	At most 1	115.2	0.0000	115.2	0.0000
Low Middle Income Countries	None	184.1	0.0000	143.5	0.0000
	At most 1	149.3	0.0000	149.3	0.0000
Upper Middle Income Countries	None	137.4	0.0000	120.1	0.0000
	At most 1	87.54	0.0002	87.54	0.0002
All Developing Countries	None	474.3	0.0000	380.4	0.0000
	At most 1	354.6	0.0000	354.6	0.0000

For LIC, LMIC, UMIC and all developing countries, both tests show that there exists LR cointegration because their probability values are in the range of 0.00-0.10. Table 18 demonstrates the results of the Pedroni residual cointegration test. It indicates probabilities of alternative hypotheses and weighted statistics.

In low-income countries out of eleven values of probability seven values come in a range of 0.00-0.10 exploring the existence of cointegration. In the GE-trade model in these countries. For LMIC just four values from eleven have the probabilities values within the range 0.00-0.10. So there is no cointegration in the GE-tax model for these countries. In the case of UMIC, six values have probability values in the range of 0.00-0.10 indicating the existence of cointegration in the GE-trade model in these countries. Similar to LMIC, all the developing countries from eleven values of probability just four values come in a range of 0.00-0.10 exploring there is no cointegration in the GE-tax model for all developing countries. In Table 19, we have used ECT to estimate long-run causality for LIC. The upper part of Table 19 indicates the no long-run causality between trade and GE. ECT is negative and insignificant which describes no long-run causality existing from the independent to the dependent variable.

Table 18: Pedroni Residual Cointegration Tests for Government Expenditures-Trade Model

Countries	Alternative Hypothesis	Stat.	Prob.	Weighted Stat.	Prob.
Low Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-0.338	0.6324	-1.511	0.9346
	Panel rho-Stat.	-0.747	0.2273	-1.143	0.1263
	Panel PP-Stat.	-1.379	0.0838	-2.813	0.0024
	Panel ADF-Stat.	-1.598	0.0549	-3.091	0.0010
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	0.610	0.7291		
	Group PP-Stat.	-2.065	0.0195		
	Group ADF-Stat.	-2.307	0.0105		
Lower Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-3.177	0.9993	-0.654	0.7435
	Panel rho-Stat.	4.720	1.0000	-0.923	0.1777
	Panel PP-Stat.	6.516	1.0000	-1.962	0.0248
	Panel ADF-Stat.	6.034	1.0000	-2.632	0.0042
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	0.560	0.7123		
	Group PP-Stat.	-1.787	0.0370		
	Group ADF-Stat.	-3.665	0.0001		
Upper Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-0.685	0.7536	-1.179	0.8808
	Panel rho-Stat.	0.208	0.5827	0.256	0.6013
	Panel PP-Stat.	-1.775	0.0379	-0.857	0.1955
	Panel ADF-Stat.	-1.789	0.0368	-1.322	0.0931
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	0.835	0.7982		
	Group PP-Stat.	-1.359	0.0869		
	Group ADF-Stat.	-2.350	0.0094		
All Developing Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-3.359	0.9996	-1.932	0.9734
	Panel rho-Stat.	4.147	1.0000	-1.027	0.1520
	Panel PP-Stat.	4.389	1.0000	-3.250	0.0006
	Panel ADF-Stat.	3.066	0.9989	-4.052	0.0000
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	1.237	0.8920		
	Group PP-Stat.	-2.861	0.0021		
	Group ADF-Stat.	-4.753	0.0000		

The lower part of Table 19 indicates long-run causality between GE and trade. ECT is also negative and significant indicating long-run causality among GE and trade. Unidirectional causality is present for the trade-GE model. To check short-run causality between GE and trade and trade and GE model for low-income countries we have used the Wald test in Table 6.20. Order C(2) and C(3) are representing the short-run causality of GE to GE while C(4) and C(5) represent the Short-run causality of trade-GE. C(8) and C(9) are representing the Short-run causality of trade to trade and C(10) and C(11) represent the Short-run causality of GE to trade.

Table 19: Long run Causality Government Expenditures-Trade Model (LIC)

		Coefficient	Std. Error	t-Stat.	Prob.
GE-Trade Model: DV=D(GE)					
C(1)	ECT	-0.003368	0.005433	-0.619984	0.5356
C(2)	D(GE(-1)	0.043225	0.044899	0.962698	0.3362
C(3)	D(GE(-2)	-0.091782	0.044557	-2.059873	0.0400
C(4)	D(TRADE(-1)	0.003270	0.013987	0.233813	0.8152
C(5)	D(TRADE(-2)	-0.000966	0.013684	-0.070563	0.9438
C(6)	CONSTANT	0.065619	0.147873	0.443750	0.6574
R^2 = 0.013			DW stat = 2.14		
Trade-GE Model: DV=D(Trade)					
C(7)	ECT	-0.040530	0.015390	-2.633600	0.0087
C(8)	D(TRADE(-1)	-0.179640	0.044711	-4.017768	0.0001
C(9)	D(TRADE(-2)	-0.106971	0.043741	-2.445571	0.0149
C(10)	D(GE(-1)	-0.026546	0.143523	-0.184962	0.8533
C(11)	D(GE(-2)	-0.100982	0.142429	-0.709001	0.4787
C(12)	CONSTANT	0.086826	0.472682	0.183688	0.8543
R^2 = 0.06			DW stat = 1.98		

Table 20: Short-run Causality based on Wald Test Results Government Expenditures-Trade Model (Low-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(GE(-1) = D(GE(-2) = 0	C(2)=C(3)=0	2.59	0.07
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	0.03	0.96
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	9.25	0.00
D(GE(-1) = D(GE(-2) = 0	C(10)= C(11)=0	0.26	0.76

The probability value of GE to GE is 0.07 elaborating that there exists short-run causality between them. Trade-GE has the probability value of 0.96 showing no short-run causality between them. The probability value of trade to trade is 0.00 indicating that there is Short-run causality between them while between GE to trade the probability value is 0.76 showing no short-run causality between them. These results show that in the GE-Trade model there exists bidirectional short-run causality while in the trade-GE model there is no presence of short-run causality. In Table 21, we have used ECT to check long-run causality for LMIC. The upper part of Table 21 indicates long-run causality among trade-GE. ECT is negative and significant which shows the presence of long-run causality running from the independent to the dependent variable. The lower part of Table 21 indicates the no long-run causality among GE-trade. ECT is also positive and insignificant demonstrating no long-run causality within GE-trade in middle-income countries. Hence, there exists no long-run causality in the trade-GE model.

Table 21: Long run Causality Government Expenditures-Trade Model (Lower Middle-Income Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
GE-Trade Model: DV=D(GE)					
C(1)	ECT	0.046238	0.007940	5.823119	0.0000
C(2)	D(GE(-1)	0.170596	0.038529	4.427681	0.0000
C(3)	D(GE(-2)	-0.103916	0.035156	-2.955822	0.0032
C(4)	D(TRADE(-1)	0.015370	0.006319	2.432319	0.0152
C(5)	D(TRADE(-2)	0.002898	0.006268	0.462355	0.6440
C(6)	CONSTANT	0.116706	0.064706	1.803641	0.0717
R^2 = 0.11			DW stat = 1.98		
Trade-GE Model: DV=D(Trade)					
C(7)	ECT	0.000757	0.003643	0.207657	0.8356
C(8)	D(TRADE(-1)	-0.003710	0.037915	-0.097844	0.9221
C(9)	D(TRADE(-2)	-0.045475	0.037609	-1.209158	0.2270
C(10)	D(GE(-1)	-0.022823	0.231178	-0.098723	0.9214
C(11)	D(GE(-2)	-0.223155	0.210940	-1.057908	0.2905
C(12)	CONSTANT	-0.083602	0.388237	-0.215338	0.8296
R^2 = 0.004			DW stat = 2.03		

To check the short-run causality between GE and trade and trade and GE model for lower-middle-income countries, we have applied the Wald test in Table 22. Order C(2) and C(3) are representing the Short-run causality of GE to GE while C(4) and C(5) are representing the short-run causality of trade-GE. C(8) and C(9) are representing the short-run causality of trade to trade and C(10) and C(11) represent the Short-run causality of GE to trade.

Table 22: Short-run Causality based on Wald Test Results Government Expenditures-Trade Model (Lower Middle-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(GE(-1) = D(GE(-2) = 0	C(2)=C(3)=0	13.75	0.00
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	3.03	0.04
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	0.73	0.48
D(GE(-1) = D(GE(-2) = 0	C(10)= C(11)=0	0.56	0.56

The probability value of GE to GE is 0.00 which represents the existence of Short-run causality between them. Trade-GE has the probability value of 0.04 showing the existence of Short-run causality among them. The probability value of trade to trade is 0.48 indicating that there is no Short-run causality between them while between GE to trade the probability value is 0.56 also showing no Short-run causality between them. These results show that both in the GE-Trade model and in the trade-GE model there is unidirectional short-run causality. In Table 23 we have used ECT to check Long-run causality for UMIC. The upper part of Table 23 indicates Long-run causality among trade-GE. ECT is negative and significant demonstrating long-run causality is present from independent to dependent variable. The lower part of Table 23 indicates no Long-run causality between GE and trade. ECT is positive and insignificant indicating no long-run causality in GE-trade for middle-income countries. The long-run causality is unidirectional in these models.

Table 23: Long run Causality Government Expenditures-Trade Model (UM IC)

		Coefficient	Std. Error	t-Stat.	Prob.
GE-Trade Model: DV=D(GE)					
C(1)	ECT	-0.050572	0.009342	-5.413408	0.0000
C(2)	D(GE(-1)	0.089907	0.040706	2.208702	0.0276
C(3)	D(GE(-2)	-0.109202	0.036915	-2.958176	0.0032
C(4)	D(TRADE(-1)	0.008435	0.004964	1.699254	0.0899
C(5)	D(TRADE(-2)	-0.001876	0.004855	-0.386362	0.6994
C(6)	CONSTANT	-0.001521	0.038211	-0.039819	0.9683
$R^2 = 0.08$			DW stat = 2.08		
Trade-GE Model:DV=D(Trade)					
C(7)	ECT	0.000114	0.000917	0.124728	0.9008
C(8)	D(TRADE(-1)	-0.073249	0.043856	-1.670205	0.0955
C(9)	D(TRADE(-2)	-0.156167	0.042890	-3.641123	0.0003
C(10)	D(GE(-1)	0.213077	0.359621	0.592504	0.5538
C(11)	D(GE(-2)	-0.609802	0.326135	-1.869786	0.0621
C(12)	CONSTANT	0.448485	0.337579	1.328533	0.1846
$R^2 = 0.03$			DW stat = 1.98		

To check short-run causality between GE and trade and trade and GE model for upper-middle-income countries, we have applied the Wald test in Table 24. Order C(2) and C(3) are representing the Short-run causality of GE to GE while C(4) and C(5) denote the short-run causality of trade-GE. While C(8) and C(9) are representing the Short-run causality of trade to trade and C(10) and C(11) represent the short-run causality of GE to trade.

Table 24: Short-run Causality based on Wald Test Results Government Expenditures-Trade Model (Upper-Middle Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(GE(-1) = D(GE(-2) = 0	C(2)=C(3)=0	6.45	0.00
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.56	0.21
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	7.69	0.00
D(GE(-1) = D(GE(-2) = 0	C(10)= C(11)=0	1.86	0.15

The probability value of GE to GE is 0.00 which indicates the presence of short-run causality between them. Trade-GE has the probability value of 0.21 showing no existence of Short-run causality between them. The probability value of trade to trade is 0.00 indicating that there is Short-run causality between them while between GE to trade the probability value is 0.15 also showing no Short-run causality between them. These results show that both in the GR-trade model there is bidirectional causality while and the trade-GR model there is no SR causality. In Table 25, we have used ECT to check Long-run causality in all the developing countries. The upper part of Table 25 indicates no long-run causality within trade-GE. ECT is positive and insignificant which shows the absence of long-run causality from independent to dependent variable.

Table 25: Long run Causality Government Expenditures-Trade Model (All Developing Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
GE-Trade Model: DV=D(GE)					
C(1)	ECT	0.000415	0.000588	0.705619	0.4805
C(2)	D(GE(-1)	0.112726	0.023206	4.857662	0.0000
C(3)	D(GE(-2)	-0.067906	0.022359	-3.037104	0.0024
C(4)	D(TRADE(-1)	0.009305	0.005087	1.829093	0.0676
C(5)	D(TRADE(-2)	0.000615	0.004999	0.122962	0.9022
C(6)	CONSTANT	0.066327	0.049517	1.339477	0.1806
$R^2 = 0.02$			DW stat = 2.07		
Trade-GE Model: DV=D(Trade)					
C(7)	ECT	-0.028392	0.006592	-4.306713	0.0000
C(8)	D(TRADE(-1)	-0.061098	0.023953	-2.550797	0.0108
C(9)	D(TRADE(-2)	-0.066524	0.023539	-2.826186	0.0048
C(10)	D(GE(-1)	-0.021618	0.109267	-0.197847	0.8432
C(11)	D(GE(-2)	-0.177954	0.105279	-1.690310	0.0912
C(12)	CONSTANT	0.072793	0.233157	0.312208	0.7549
$R^2 = 0.02$			DW stat = 2.00		

The lower part of Table 25 indicates long-run causality within GE and trade. ECT is negative and significant indicating the presence of Long-run causality between GE-trade in all developing countries. Long-run causality is unidirectional in these models. To check the short-run causality between GE and trade and trade and GE model for all developing countries, we have applied the Wald test in Table 26. Order C(2) and C(3) are representing the Short-run causality of GE to GE while C(4) and C(5) represent the short-run causality of trade-GE. Whereas C(8) and C(9) represent the Short-run causality of trade to trade and C(10) and C(11) represent the Short-run causality of GE to trade.

Table 26: Short-run Causality based on Wald Test Results Government Expenditures-Trade Model (All Developing Countries)

Null Hypothesis		F-Stat.	Prob.
D(GE(-1) = D(GE(-2) = 0	C(2)=C(3)=0	15.53	0.00
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.67	0.18
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	6.53	0.00
D(GE(-1) = D(GE(-2) = 0	C(10)= C(11)=0	1.47	0.22

The probability value of GE to GE is 0.00 representing the existence of Short-run causality between them. Trade to GE has the probability value of 0.18 showing an absence of causality between them. The probability value of trade to trade 0.00 indicates that there is short-run causality between them while between GE to trade the probability value is 0.22 showing there is no Short-run causality between them. These results show that in the GR-trade model there is bidirectional causality while in the trade-GR model there is no causality. Table 27 consists of the results of the Kao residual cointegration tests for the ED-trade model for all the countries (LIC, LMIC, UMIC and all the developing countries). probability values show the presence of cointegration (LR relationship) in the GE-trade model within all countries.

Table 27: Kao Residual Cointegration Tests for Public Debt-Trade Model

Countries	ADF t-Stat.	ADF Prob.
Low Income Countries	-1.80	0.03
Low Middle-Income Countries	-0.94	0.17
Upper Middle-Income Countries	-2.63	0.00
All Developing Countries	-3.17	0.00

The second step to check the cointegration is the Johnsen Fisher panel cointegration test. It has been divided into two tests one is the Trace test another is the Max-Eigen test. For low income, lower middle income, upper middle income and all countries both tests show that there exists LR cointegration because their probability values are in the range of 0.00-0.10.

Table 28: Johansen Fisher Panel Cointegration Test for Public Debt-Trade Model

Countries	Hypothesized No. of CE(s)	Fisher Stat. (Trace test)	Prob.	Fisher Stat. (Max-Eigen test)	Prob.
Low Income Countries	None	68.29	0.0004	57.66	0.0069
	At most 1	60.67	0.0033	60.67	0.0033
Low Middle Income Countries	None	175.4	0.0000	143.1	0.0000
	At most 1	144.1	0.0000	144.1	0.0000
Upper Middle Income Countries	None	94.02	0.0001	69.20	0.0242
	At most 1	107.6	0.0000	107.6	0.0000
All Developing Countries	None	340.4	0.0000	273.1	0.0000
	At most 1	313.5	0.0000	313.5	0.0000

Table 29 demonstrates the results of the Pedroni residual cointegration test. It indicates the probabilities values of alternative hypotheses and weighted statistics. In low-income countries, out of eleven values of probability, no value comes in the range of 0.00-0.10, which means there is no cointegration in the ED-trade model in these countries. In the case of LMIC, nine values from eleven have probabilities within the range of 0.00-0.10. So there is cointegration in the ED-tax model for LMIC. While in UMIC four values of probability are in the range of 0.00-0.10 indicating that there is no cointegration in the ED-trade model.

In developing countries, out of eleven values of probability six values come in a range of 0.00-0.10 exploring there is cointegration in the ED-tax model for all developing countries. In Table 30, we have used ECT to test Long-run causality for low-income countries. The upper part of Table 30 indicates Long-run causality within trade-ED. ECT is negative and significant showing the presence of Long-run causality from independent to dependent variable. The lower part of Table 30 indicates the Long-run causality among ED-trade. ECT is negative and significant indicating there is long-run causality between ED and trade in low-income countries. In both models, the long-run causality is bidirectional.

For checking short-run causality between ED and trade and trade and ED model for low-income countries, we have applied the Wald test in Table 31. Order C(2) and C(3) are representing the Short-run causality of ED to ED while C(4) and C(5) represent the SR causality of trade to ED. On the other side, C(8) and C(9) represent the Short-run causality of trade to trade and C(10) and C(11) represent the Short-run causality of ED to trade. The probability value of ED to ED is 0.00 showing Short-run causality between them. Trade-ED has the probability value of 0.52 showing no existence of Short-run causality between them. A probability value of trade to trade is 0.00 indicating that there is short-run causality between them while between ED to trade the probability value is 0.55 showing there is no Short-run causality between them. These results show that in the ED-trade model there is bidirectional causality while in the trade-ED model there is no causality.

In Table 32, we have used ECT to probe long-run causality for LMIC. The upper part of Table 32 indicates long-run causality between trade and ED. ECT is negative and significant which shows that there is long-run causality. The lower part of Table 32 indicates the no long-run causality between ED and trade. ECT is negative and insignificant indicating there is no long-run causality between ED and trade in LMIC. So there is unidirectional long-run causality.

To examine the short-run causality between ED and trade and trade and ED model for lower-middle-income countries, we have applied the Wald test in Table 33. Order C(2) and C(3) are representing the Short-run causality of ED to ED while C(4) and C(5) are representing the Short-run causality of trade and ED. While, C(8) and C(9) are representing the Short-run causality of trade to trade and C(10), C(11) are representing the Short-run causality of ED to trade. The probability value of ED to ED is 0.01 which shows the existence of Short-run causality between them. Trade-ED has the probability value of 0.85 showing no presence of Short-run causality between them. A probability value of trade to trade is 0.41 indicating that there is no Short-run causality between them while between ED to trade the probability value is 0.02 indicating there is Short-run causality between them. These results show that both in the ED-trade model and trade-ED model, there is unidirectional causality.

Table 29: Pedroni Residual Cointegration Tests for Public Debt-Trade Model

Countries	Alternative Hypothesis	Stat.	Prob.	Weighted Stat.	Prob.
Low Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-0.577	0.7183	-2.165	0.9848
	Panel rho-Stat.	1.113	0.8673	0.696	0.7570
	Panel PP-Stat.	0.114	0.5456	-0.245	0.4029
	Panel ADF-Stat.	0.694	0.7563	-0.196	0.4220
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	1.084	0.8610		
	Group PP-Stat.	0.036	0.5145		
	Group ADF-Stat.	0.240	0.5952		
Lower Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	1.456	0.0727	-0.506	0.6939
	Panel rho-Stat.	-2.007	0.0224	-1.589	0.0560
	Panel PP-Stat.	-7.282	0.0000	-3.470	0.0003
	Panel ADF-Stat.	-9.105	0.0000	-4.191	0.0000
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	0.565	0.7141		
	Group PP-Stat.	-3.345	0.0004		
	Group ADF-Stat.	-5.484	0.0000		
Upper Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-0.223	0.5882	0.329	0.3710
	Panel rho-Stat.	-0.122	0.4511	-0.525	0.2997
	Panel PP-Stat.	-0.985	0.1622	-1.405	0.0799
	Panel ADF-Stat.	-0.608	0.2713	-1.206	0.1139
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	0.576	0.7178		
	Group PP-Stat.	-1.793	0.0365		
	Group ADF-Stat.	-2.615	0.0045		
All Developing Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-0.204	0.5809	-1.693	0.9548
	Panel rho-Stat.	0.553	0.7099	-0.646	0.2589
	Panel PP-Stat.	-2.722	0.0032	-2.849	0.0022
	Panel ADF-Stat.	-2.445	0.0072	-3.099	0.0010
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	1.274	0.8988		
	Group PP-Stat.	-3.051	0.0011		
	Group ADF-Stat.	-4.791	0.0000		

Table 30: Long run Causality Public Debt-Trade Model (LIC)

		Coefficient	Std. Error	t-Stat.	Prob.
ED-Trade Model: DV=D(ED)					
C(1)	ECT	-0.005670	0.003334	-1.700738	0.0897
C(2)	D(ED(-1)	-0.092623	0.047205	-1.962143	0.0504
C(3)	D(ED(-2)	0.147268	0.046952	3.136567	0.0018
C(4)	D(TRADE(-1)	-0.001699	0.004324	-0.392986	0.6945
C(5)	D(TRADE(-2)	-0.004766	0.004236	-1.125136	0.2612
C(6)	CONSTANT	0.039655	0.045951	0.862981	0.3886
R^2 = 0.04			DW stat = 2.04		
Trade-ED Model: DV=D(Trade)					
C(7)	ECT	-0.042515	0.015690	-2.709682	0.0070
C(8)	D(TRADE(-1)	-0.181142	0.044631	-4.058653	0.0001
C(9)	D(TRADE(-2)	-0.106729	0.043678	-2.443525	0.0149

C(10)	D(ED(-1)	0.529047	0.487207	1.085877	0.2781
C(11)	D(ED(-2)	0.086458	0.483304	0.178890	0.8581
C(12)	CONSTANT	0.048090	0.473280	0.101610	0.9191
$R^2 = 0.06$			DW stat = 1.98		

Table 31: Short-run Causality based on Wald Test Results in Public Debt-Trade Model (Low-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(ED(-1) = D(ED(-2) = 0	C(2)=C(3)=0	7.63	0.00
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	0.64	0.52
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	9.40	0.00
D(ED(-1) = D(ED(-2) = 0	C(10)= C(11)=0	0.59	0.55

Table 32: Long run Causality Public Debt-Trade Model (Lower Middle-Income Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
ED-Trade Model: DV=D(ED)					
C(1)	ECT	-0.084135	0.016739	-5.026198	0.0000
C(2)	D(ED(-1)	0.008821	0.037165	0.237351	0.8125
C(3)	D(ED(-2)	0.081099	0.028254	2.870309	0.0042
C(4)	D(TRADE(-1)	1.80E-05	0.001692	0.010657	0.9915
C(5)	D(TRADE(-2)	-0.000918	0.001667	-0.550638	0.5821
C(6)	CONSTANT	-0.015037	0.017451	-0.861661	0.3892
$R^2 = 0.04$			DW stat = 1.98		
Trade-ED Model: DV=D(Trade)					
C(7)	ECT	-0.003142	0.003151	-0.997155	0.3190
C(8)	D(TRADE(-1)	-0.001014	0.037397	-0.027113	0.9784
C(9)	D(TRADE(-2)	-0.048788	0.036842	-1.324252	0.1858
C(10)	D(ED(-1)	-0.078447	0.821501	-0.095492	0.9240
C(11)	D(ED(-2)	1.734392	0.624563	2.776971	0.0056
C(12)	CONSTANT	-0.055278	0.385481	-0.143399	0.8860
$R^2 = 0.02$			DW stat = 2.04		

Table 33: Short-run Causality based on Wald Test Results in Public Debt-Trade Model (Lower Middle-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(ED(-1) = D(ED(-2) = 0	C(2)=C(3)=0	4.17	0.01
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	0.87	0.85
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	0.87	0.41
D(ED(-1) = D(ED(-2) = 0	C(10)= C(11)=0	3.85	0.02

In Table 34, we have used ECT to check the long-run causality for UMIC. The upper part of Table 34 indicates long-run causality between trade and ED. ECT is negative and significant which shows that there is Long-run causality.

The lower part of Table 34 indicates the long-run causality between ED and trade. ECT is negative and insignificant indicating there is no long-run causality between ED and trade in upper-income countries. Therefore, there is unidirectional long-run causality. To check the Short-run causality between ED and trade and trade and ED model for upper-middle-income countries, we applied the Wald test in Table 35. Order C(2) and C(3) are representing the Short-run causality of ED to ED while C(4) and C(5) are representing the short-run causality of trade-ED. Whereas C(8) and C(9) are representing the Short-run causality trade to trade and C(10) and C(11) represent the short-run causality of ED to trade. The probability value of ED to ED is 0.68 showing no SR causation between them. Trade-ED has the probability value of 0.15 showing the absence of Short-run causality between them. A probability value of trade to trade is 0.00 indicating that there is short-run causality between them while between ED to trade the probability value is 0.62 showing there is no Short-run causality between them. These results show that in ED-trade model there is unidirectional causality while in the trade-ED model, there is no causality.

Table 34: Long run Causality Public Debt-Trade Model (UMIC)

		C.E	S.E	t-Stat.	Prob.
ED-Trade Model: DV=D(ED)					
C(1)	ECT	-0.091490	0.017706	-5.167109	0.0000
C(2)	D(ED(-1)	0.022353	0.044047	0.507478	0.6120
C(3)	D(ED(-2)	0.032057	0.043484	0.737197	0.4614
C(4)	D(TRADE(-1)	0.004371	0.003117	1.402461	0.1614
C(5)	D(TRADE(-2)	-0.003688	0.003050	-1.209383	0.2271
C(6)	CONSTANT	-0.010087	0.024061	-0.419211	0.6752
R^2 = 0.06			DW stat = 1.98		
Trade-ED Model: DV=D(Trade)					
C(7)	ECT	-0.001244	0.001793	-0.693851	0.4881
C(8)	D(TRADE(-1)	-0.079934	0.043830	-1.823728	0.0688
C(9)	D(TRADE(-2)	-0.144524	0.042902	-3.368710	0.0008
C(10)	D(ED(-1)	0.425586	0.619624	0.686846	0.4925
C(11)	D(ED(-2)	-0.389860	0.611597	-0.637447	0.5241
C(12)	CONSTANT	0.418534	0.338194	1.237555	0.2165
R^2 = 0.03			DW stat = 1.99		

Table 35: Short-run Causality based on Wald Test Results in Public Debt-Trade Model (Upper-Middle Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(ED(-1) = D(ED(-2) = 0	C(2)=C(3)=0	0.38	0.68
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.86	0.15
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	6.89	0.00
D(ED(-1) = D(ED(-2) = 0	C(10)= C(11)=0	0.46	0.62

In Table 36, we have used ECT to check Long-run causality for all the developing countries. The upper part of Table 36 indicates the Long-run causality between trade and ED. ECT is negative and significant which shows that there is Long-run causality running from the independent to the dependent variable. The lower part of Table 35 indicates the Long-run causality between ED and trade. ECT is negative and significant indicating there is long-run causality between ED and trade in all the developing income countries. In both models, the long-run causality is bidirectional.

Table 36: Long run Causality Public Debt-Trade Model (All Developing Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
ED-Trade Model: DV=D(ED)					
C(1)	ECT	-0.004794	0.001870	-2.563251	0.0105
C(2)	D(ED(-1)	-0.065440	0.024007	-2.725913	0.0065
C(3)	D(ED(-2)	0.091295	0.022242	4.104687	0.0000
C(4)	D(TRADE(-1)	0.000947	0.001646	0.575292	0.5652
C(5)	D(TRADE(-2)	-0.002291	0.001617	-1.416962	0.1567
C(6)	CONSTANT	0.001544	0.016008	0.096462	0.9232
R^2 = 0.02			DW stat = 2.01		
Trade-ED Model: DV=D(Trade)					
C(7)	ECT	-0.026759	0.006443	-4.153041	0.0000
C(8)	D(TRADE(-1)	-0.063905	0.023971	-2.665970	0.0078
C(9)	D(TRADE(-2)	-0.069362	0.023537	-2.946988	0.0033
C(10)	D(ED(-1)	0.515546	0.349595	1.474693	0.1405
C(11)	D(ED(-2)	0.569229	0.323425	1.760002	0.0786
C(12)	CONSTANT	0.056371	0.232842	0.242100	0.8087
R^2 = 0.02			DW stat = 2.00		

To check the short run causality between ED and trade and trade and ED model for all the developing countries, we applied the Wald test in Table 37. Order C(2) and C(3) are representing the Short-run causality of ED to ED while C(4) and C(5) are representing the Short-run causality of trade-ED. While C(8) and C(9) represent the Short-run causality trade to trade and C(10) and C(11) exhibit the short-run causality of ED to trade. The probability value of ED to ED is 0.00 representing the existence of short-run causality between them.

Table 37: Short-run Causality based on Wald Test Results in Public Debt-Trade Model (All Developing Countries)

Null Hypothesis		F-Stat.	Prob.
D(ED(-1) = D(ED(-2) = 0	C(2)=C(3)=0	12.56	0.00
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.27	0.27
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	7.11	0.00
D(ED(-1) = D(ED(-2) = 0	C(10)= C(11)=0	2.54	0.07

Trade-ED has the probability value of 0.27 showing no short-run causality between them. probability of trade to trade is 0.00 indicating that there is short-run causality between them while between ED to trade the probability value is 0.07 showing there is short-run causality between them. These results show that in the ED-trade model there is bidirectional causality while in the trade-ED model, there is unidirectional causality. Table 38 consists of the results of the Kao residual cointegration tests for the ODA-trade model for all the countries (low income, low-middle income, upper-middle-income and all the developing countries). The probability values show that there exists cointegration (LR relationship) in the ODA-trade model in all countries.

Table 38: Kao Residual Cointegration Tests for ODA-Trade Model

Countries	ADF t-Stat.	ADF Prob.
Low Income Countries	-4.02	0.00
Low Middle-Income Countries	-1.72	0.04
Upper Middle-Income Countries	-4.69	0.00
All Developing Countries	-7.06	0.00

The second step to check the cointegration is the Johnsen Fisher panel cointegration test. For low income, lower middle income, upper middle income and all countries both tests show that there exists LR cointegration because their probability values are in the range of 0.00-0.10.

Table 39: Johansen Fisher Panel Cointegration Test for ODA-Trade Model

Countries	Hypothesized No. of CE(s)	Fisher Stat. (Trace test)	Prob.	Fisher Stat. (Max-Eigen test)	Prob.
Low Income Countries	None	101.4	0.0000	81.80	0.0001
	At most 1	85.62	0.0000	85.62	0.0000
Low Middle Income Countries	None	139.8	0.0000	104.8	0.0028
	At most 1	148.9	0.0000	148.9	0.0000
Upper Middle Income Countries	None	160.7	0.0000	118.8	0.0000
	At most 1	129.5	0.0000	129.5	0.0000
All Developing Countries	None	436.4	0.0000	337.8	0.0000
	At most 1	378.6	0.0000	378.6	0.0000

Table 40 demonstrates the results of Pedroni residual cointegration test. It indicates the probabilities values of alternative hypothesis and weighted statistics. In low-income countries, out of eleven values of probability eight values come in the range of 0.00-0.10. It means there exists cointegration in the ODA-trade model in these countries.

Table 40: Pedroni Residual Cointegration Tests for ODA-Trade Model

Countries	Alternative Hypothesis	Stat.	Prob.	Weighted Stat.	Prob.
Low Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	1.168	0.1213	-0.725	0.7659
	Panel rho-Stat.	-3.417	0.0003	-3.797	0.0001
	Panel PP-Stat.	-3.995	0.0000	-4.633	0.0000
	Panel ADF-Stat.	-3.759	0.0001	-4.429	0.0000

	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-0.915	0.1800		
	Group PP-Stat.	-3.247	0.0006		
	Group ADF-Stat.	-3.354	0.0004		
Lower Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	-0.116	0.5466	-1.223	0.8895
	Panel rho-Stat.	-3.793	0.0001	-6.168	0.0000
	Panel PP-Stat.	-6.280	0.0000	-7.557	0.0000
	Panel ADF-Stat.	-6.196	0.0000	-7.939	0.0000
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-4.322	0.0000		
	Group PP-Stat.	-7.512	0.0000		
	Group ADF-Stat.	-7.403	0.0000		
Upper Middle Income Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	1.370	0.0853	-1.107	0.8660
	Panel rho-Stat.	-7.406	0.0000	-5.224	0.0000
	Panel PP-Stat.	-10.484	0.0000	-6.861	0.0000
	Panel ADF-Stat.	-7.357	0.0000	-5.761	0.0000
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-3.010	0.0013		
	Group PP-Stat.	-6.578	0.0000		
	Group ADF-Stat.	-5.274	0.0000		
All Developing Countries	Common AR coefficients (within-dimension)				
	Panel v-Stat.	2.012	0.0221	-1.883	0.9702
	Panel rho-Stat.	-6.710	0.0000	-9.524	0.0000
	Panel PP-Stat.	-8.177	0.0000	-11.806	0.0000
	Panel ADF-Stat.	-7.599	0.0000	-11.416	0.0000
	Individual AR coefficients (Between-dimension)				
	Group rho-Stat.	-5.278	0.0000		
	Group PP-Stat.	-10.596	0.0000		
	Group ADF-Stat.	-9.867	0.0000		

Table 41: Long run Causality ODA-Trade Model (Low-Income Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
ODA-Trade Model: DV=D(ODA)					
C(1)	ECT	-0.091057	0.024050	-3.786164	0.0002
C(2)	D(ODA(-1)	-0.054608	0.048468	-1.126665	0.2605
C(3)	D(ODA(-2)	-0.111043	0.047298	-2.347727	0.0193
C(4)	D(TRADE(-1)	0.074296	0.044757	1.659967	0.0976
C(5)	D(TRADE(-2)	0.064259	0.044203	1.453698	0.1468
C(6)	CONSTANT	-0.206225	0.479547	-0.430041	0.6674
$R^2 = 0.07$			DW stat = 2.04		
Trade-ODA Model: DV=D(Trade)					
C(7)	ECT	-0.003124	0.003314	-0.942793	0.3463
C(8)	D(TRADE(-1)	-0.197671	0.044452	-4.446844	0.0000
C(9)	D(TRADE(-2)	-0.120532	0.043860	-2.748112	0.0062
C(10)	D(ODA(-1)	-0.021883	0.048139	-0.454588	0.6496
C(11)	D(ODA(-2)	-0.045487	0.046977	-0.968294	0.3334
C(12)	CONSTANT	0.058320	0.475757	0.122583	0.9025
$R^2 = 0.05$			DW stat = 2.00		

For LMIC, nine values from eleven have probabilities values within the range of 0.00-0.10. So, there is cointegration in the ODA-tax model for LMIC. Like LMIC, UMIC has nine values out of eleven with probability values in the range of 0.00-0.10 indicating that there is cointegration in the ODA-trade model. In all developing economies out of eleven values of probability ten values come in a range of 0.00-0.10 exhibiting that there is cointegration in the ODA-tax model for all developing countries. In Table 41, we have used ECT to check long-run causality for low-income countries. The upper part of Table 41 indicates Long-run causality among trade-ODA. ECT is negative and significant which shows that there is long-run causality. The lower part of Table 41 indicates the no long-run causality between ODA and trade.

For estimating short-run causality between ODA and trade and trade and ODA model for low-income countries, we have applied the Wald test in Tabl 42. Order C(2) and C(3) are representing the Short-run causality of ODA to ODA while C(4) and C(5) are representing the Short-run causality of trade and ODA. While C(8) and C(9) exhibit the Short-run causality trade to trade and C(10) and C(11) represent the Short-run causality of ODA to trade. The probability value of ODA to ODA is 0.04 highlighting the Short-run causality between them. Trade-ODA has the probability value of 0.13 showing no Short-run causality between them. A probability value of trade to trade is 0.00 indicating that there is Short-run causality between them while between ODA to trade the probability value is 0.59 showing there is no Short-run causality between them. These results show that in the ODA-trade model there is unidirectional Short-run causality while and the trade-ODA model, there is no causality.

Table 42: Short-run Causality based on Wald Test Results ODA-Trade Model (Low-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(ODA(-1) = D(ODA(-2) = 0	C(2)=C(3)=0	3.05	0.04
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.99	0.13
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	11.52	0.00
D(ODA(-1) = D(ODA(-2) = 0	C(10)= C(11)=0	0.51	0.59

In Table 43, we have used ECT to check Long-run causality for LMIC. The upper part of Table 43 indicates long-run causality within trade-ODA. ECT is negative and significant which shows the presence of long-run causality from independent toward dependent variable.

Table 43: Long run Causality ODA-Trade Model (LMIC)

		Coefficient	Std. Error	t-Stat.	Prob.
ODA-Trade Model: DV=D(ODA)					
C(1)	ECT	-0.089099	0.016640	-5.354356	0.0000
C(2)	D(ODA(-1)	-0.189636	0.037189	-5.099272	0.0000
C(3)	D(ODA(-2)	-0.089877	0.035357	-2.541948	0.0112
C(4)	D(TRADE(-1)	-0.011424	0.010523	-1.085547	0.2780
C(5)	D(TRADE(-2)	0.007362	0.010349	0.711368	0.4771
C(6)	CONSTANT	-0.206785	0.107420	-1.925006	0.0546
R^2 = 0.10			DW stat = 2.04		
Trade-ODA Model: DV=D(Trade)					
C(7)	ECT	-4.35E-05	6.15E-05	-0.707851	0.4793
C(8)	D(TRADE(-1)	-0.015600	0.038024	-0.410271	0.6817
C(9)	D(TRADE(-2)	-0.046608	0.037388	-1.246613	0.2130
C(10)	D(ODA(-1)	0.251559	0.134354	1.872355	0.0616
C(11)	D(ODA(-2)	0.091691	0.127734	0.717822	0.4731
C(12)	CONSTANT	-0.052006	0.387909	-0.134069	0.8934
R^2 = 0.09			DW stat = 2.03		

The lower part of Table 43 indicates no long-run causality between ODA-trade. ECT is negative and insignificant indicating the existence of no long-run causality within ODA to trade in LMIC.

To check the short-run causality between ODA and trade and trade and ODA model for low-income countries, we have applied the Wald test in Table 44. Order C(2) and C(3) are representing the Short-run causality of ODA to ODA while C(4) and C(5) represent the Short-run causality of trade-ODA. While C(8) and C(9) denote short-run causality trade to trade and C(10) and C(11) represent the Short-run causality of ODA to trade. The probability value of ODA to ODA is 0.00 demonstrating Short-run causality between them. Trade-ODA has the probability value of 0.42 showing the absence of Short-run causality between them. The probability value of trade to trade is 0.42 indicating that there is no Short-run causality between them while between ODA to trade the probability value is 0.16 showing there is no Short-run causality between them. These results show that in the ODA-trade model there is unidirectional causality while in and trade-ODA model, there is no causality.

Table 44: Short-run Causality based on Wald Test Results ODA-Trade Model (Lower Middle-Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(ODA(-1) = D(ODA(-2) = 0	C(2)=C(3)=0	14.02	0.000
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	0.85	0.42
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	0.85	0.42
D(ODA(-1) = D(ODA(-2) = 0	C(10)= C(11)=0	1.79	0.16

In Table 45, we have used ECT to check Long-run causality for UMIC. The upper part of Table 45 indicates Long-run causality among trade-ODA. ECT is negative and significant showing the presence of Long-run causality running from the independent to the dependent variable. The lower part of Table 45 indicates no long-run causality between ODA and trade. ECT is positive and insignificant indicating there is no long-run causality between ODA-trade in upper-middle-income countries. In both models, the long-run causality is unidirectional.

Table 45: Long run Causality ODA-Trade Model (UMIC)

		Coefficient	Std. Error	t-Stat.	Prob.
ODA-Trade Model: DV=D(ODA)					
C(1)	ECT	-0.114926	0.020046	-5.732985	0.0000
C(2)	D(ODA(-1)	-0.240627	0.042005	-5.728545	0.0000
C(3)	D(ODA(-2)	-0.087512	0.038902	-2.249573	0.0249
C(4)	D(TRADE(-1)	0.003421	0.008268	0.413798	0.6792
C(5)	D(TRADE(-2)	-0.016695	0.008071	-2.068410	0.0391
C(6)	CONSTANT	-0.038923	0.063912	-0.609006	0.5428
R^2 = 0.14			DW stat = 1.99		
Trade-ODA Model: DV=D(Trade)					
C(7)	ECT	0.000277	0.000390	0.708903	0.4787
C(8)	D(TRADE(-1)	-0.081925	0.043468	-1.884711	0.0601
C(9)	D(TRADE(-2)	-0.154132	0.042435	-3.632225	0.0003
C(10)	D(ADA(-1)	0.256991	0.220840	1.163701	0.2451
C(11)	D(ADA(-2)	0.571428	0.204524	2.793937	0.0054
C(12)	CONSTANT	0.474488	0.336014	1.412108	0.1585
R^2 = 0.04			DW stat = 2.00		

To check short-run causality between ODA and trade and trade and ODA model for upper-middle-income countries, we have applied the Wald test in Table 46. Order C(2) and C(3) are representing the Short-run causality of ODA to ODA while C(4) and C(5) represent the Short-run causality of trade-ODA.

Table 46: Short-run Causality based on Wald Test Results ODA-Trade Model (Upper-Middle Income Countries)

Null Hypothesis		F-Stat.	Prob.
D(ODA(-1) = D(ODA(-2) = 0	C(2)=C(3)=0	17.00	0.00
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	2.30	0.10
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	7.90	0.00
D(ODA(-1) = D(ODA(-2) = 0	C(10)= C(11)=0	4.08	0.07

C(8) and C(9) are representing the Short-run causality trade to trade and C(10) and C(11) represent the Short-run causality of ODA to trade. The probability value of ODA to ODA is 0.00 demonstrating Short-run causality between them. Trade-ODA has a probability value of 0.10 showing the presence of Short-run causality among them. The probability value of trade to trade is 0.00 indicating that there is Short-run causality between them while between ODA to trade the probability value is 0.07 showing there is Short-run causality between them. These results show that in both the ODA-trade model and trade-ODA models, there is bidirectional causality. In Table 47, we have used ECT to check Long-run causality for all developing countries. The upper part of Table 47 indicates long-run causality among trade to ODA. ECT is negative and significant which shows that there is Long-run causality running from the independent to the dependent variable. The lower part of Table 47 indicates the no long-run causality within ODA and trade. ECT is positive and insignificant indicating there is no Long-run causality between ODA and trade-in upper-middle-income countries. In both models, long-run causality is unidirectional.

To check short-run causality between ODA and trade and trade and ODA model for all developing countries, we applied the Wald test in Table 46. Order C(2) and C(3) are representing the Short-run causality of ODA to ODA while C(4) and C(5) represent the Short-run causality of trade and ODA, C(8) and C(9) represent the Short-run causality trade to trade and C(10) and C(11) representing the Short-run causality of ODA to trade. The probability value of ODA to ODA is 0.00 shows there exists Short-run causality between them. Trade-ODA has the probability value of 0.15 showing the absence of Short-run causality between them.

Table 47: Long run Causality ODA-Trade Model (All Developing Countries)

		Coefficient	Std. Error	t-Stat.	Prob.
ODA-Trade Model: DV=D(ODA)					
C(1)	ECT	-0.085266	0.011344	-7.516748	0.0000
C(2)	D(ODA(-1)	-0.078981	0.024497	-3.224058	0.0013
C(3)	D(ODA(-2)	-0.112535	0.023861	-4.716294	0.0000
C(4)	D(TRADE(-1)	0.017429	0.013725	1.269838	0.2043
C(5)	D(TRADE(-2)	0.021193	0.013520	1.567517	0.1172
C(6)	CONSTANT	-0.155532	0.135296	-1.149566	0.2505
$R^2 = 0.07$			DW stat = 2.05		
Trade-ODA Model: DV=D(Trade)					
C(7)	ECT	4.38E-05	0.000726	0.060301	0.9519
C(8)	D(TRADE(-1)	-0.077967	0.023807	-3.274998	0.0011
C(9)	D(TRADE(-2)	-0.081977	0.023443	-3.496898	0.0005
C(10)	D(ODA(-1)	0.031046	0.042491	0.730636	0.4651
C(11)	D(ODA(-2)	0.000261	0.041387	0.006303	0.9950
C(12)	CONSTANT	0.063624	0.234545	0.271264	0.7862
$R^2 = 0.01$			DW stat = 2.00		

Table 48: Short-run Causality based on Wald Test Results ODA-Trade Model (All Developing Countries)

Null Hypothesis		F-Stat.	Prob.
D(ODA(-1) = D(ODA(-2) = 0	C(2)=C(3)=0	14.26	0.00
D(TRADE(-1) = D(TRADE(-2) = 0	C(4)= C(5)=0	1.86	0.15
D(TRADE(-1) = D(TRADE(-2) = 0	C(8)= C(9)=0	10.52	0.00
D(ODA(-1) = D(ODA(-2) = 0	C(10)= C(11)=0	0.27	0.76

The probability value of trade to trade is 0.00 indicating that there is short-run causality between them while between ODA to trade the probability value is 0.76 indicating that there is no short-run causality between them. These results indicate in both ODA-trade models, there is bidirectional short-run causality while in trade-ODA models, there is no short-run causality.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The main purpose of the paper is to find out the causality whether it is unidirectional, bidirectional or no causality. In the tax-trade and trade-tax model for all the countries, causality is bidirectional in the long run while the short-run causality differs from country to country. In low-income countries, the short-run causality is unidirectional. For LMIC there exists no causality. For UMIC as well as all developing countries causality is unidirectional. For GE-trade and trade-GE models, for all countries the long-run causality is bidirectional, but the short-run causality differs. For LIC, the short-run causality is bidirectional. For LMIC both in GE-trade and trade-GE model, the causality is unidirectional. For upper middle income and all countries in the GE-trade model, the causality is bidirectional and, in the trade,-GE model, there is no causality. Similarly in ED-trade and trade-ED models and ODA-trade and trade-ODA models, there is bidirectional causality in almost all countries while the short-run causality differs from country to country. Based on results, policymakers may formulate trade openness policies to accelerate tax revenues as well as government expenditures in developing countries.

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