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The Harberger-Laursen-Metzler Effect and Dutch Disease Problem: Evidence from South and Southeast Asia

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This paper aims to investigate the Harberger-Laursen-Metzler effect in the context of fourteen selected countries from South and Southeast Asia using relevant annual data from 2000 to 2016. In addition, an attempt is made to link terms of trade shocks to initiation of the Dutch Disease problem in the local economies. Two subpanels are also considered to detect the possible SAARC and ASEAN region-specific nature of the association between terms of trade and current account balance. The study employed panel fixed effects estimation techniques to estimate the elasticities of the explanatory variables considered in the paper. Panel cointegration, vector error correction model and Granger causality tests are also considered for robustness of the findings. According to the findings, a non-linear relationship between terms of trade and current account movements is identified, revealing evidence of Obstfeld-Svensson-Razin effects which states that the HLM effect depends on the persistent nature of the TOT shock. Moreover, shocks in the terms of trade are found to be ineffective in stimulating the Dutch Disease problem.

Keywords: HLM effect, South Asia, Southeast Asia, terms of trade
Field of Research: Economics

1. Introduction

Globalization has become an important tool in the attainment of economic advancement all around the globe, irrespective of an economy being developed or underdeveloped. Many countries, traditionally been characterized by closed economies, have opened up with time through execution of policies aimed at both trade and financial liberalization. It is believed that globalization, particularly through liberalization of international trade legislation would engage more and more countries in participation in bilateral and multilateral trade activities which would ultimately benefit those nations attributing to their economic development. However, liberalizing trade barriers at times deploy the risk of imports outpacing exports whereby an economy may face a net exports deficit, stalling its overall rate of economic growth. Thus, the role of terms of trade (TOT), complementing trade openness, comes into the limelight through which this problem can be tackled to some extent. An improvement in TOT is usually believed to enhance the export volumes in the home country (the country experiencing a TOT shock) and help it to be a net exporter. However, on the flip side of the coin, a rise in the TOT has also been found to trigger adverse impacts on the economy as well. For instance, it has often been associated to stimulating inflationary pressures on the economy (Desormeaux, 2009) and also attributing to worsening of the Current Account (CA) in the home economy (Obstfeld,

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1982). Although inflation, at times, somewhat helps in incentivizing local investments necessary to expedite industrialization in developing economies, a rise in CA deficit is not desirable from the development perspective of the home economy since it may stall the pace of overall economic welfare.

TOT and CA balance are two crucial macroeconomic variables that exert multidimensional impacts on the economy as a whole. For instance, a shock in TOT can disrupt national savings and in turn dampen investments necessary for the attainment of economic development goals (Otto, 2003). Some studies have also shed shreds of evidence on an improvement in TOT attributing to cost-push inflationary pressures leading to unfavorable macroeconomic consequences as well (Carlin and Soskice (2006). Apart from its adverse impacts, a TOT improvement is also believed to be a conduit for socioeconomic development. Often, an improvement in a country's TOT index is associated with the relative expansion of its export sector and thereby adding to the net exports value. Thus, a positive association between TOT and CA balance can be hypothesized in light of this theoretical argument. On the other hand, CA balance is considered to be a befitting indicator of the home economy's health. It tends to classify the nation with regards to being either a net lender or a net borrower, with the former always being a preferable tag to achieve. A surge in the CA balance can ideally be compared to a rise in the national savings which would eventually be translated into higher purchasing powers of the local people. Conversely, an enlargement of the CA deficit can work the other way round, making the home country dependent on foreign assistance and their associated disbursement burdens. Thus, countries that are characterized as open economies are quite vulnerable to TOT shocks leading to worsening of their CA balances.

The positive association between a country’s TOT index and its CAD figure was first put forward by Harberger (1950) and Laursen and Metzler (1950) which later on was referred to as the Harberger-Laursen-Metzler (HLM) effect. The conventional Keynesian economics conjuncture of the HLM effect asserts that an improvement in the exogenous TOT within a nation, that has the ultimate objective to enhancing its volume of exports at a faster rate than its imports, results in a rise in its CA balance, *ceteris paribus*. However, this positive nexus was debunked in the 1980s when Sachs (1981) argued that the response of the CA following a shock in the TOT actually depends on whether the shock is temporary or permanent, rather than the shock itself. Thus, there has been ambiguity in terms of conclusions made with respect to the relationship between TOT and CA. For instance, in a study by Lukáčik *et al.* (2016), the authors concluded that shocks in TOT exerted opposite effects on the CAD of Slovakia which was pretty much similar to the remarks made in the paper by Rakshit *et al.* (2015) in context of Bangladesh. The aim of this paper is to analyze the HLM effect, in light of conventional economic theory and practice, incorporating annual time series data between 2000 and 2016 from selected countries from South and Southeast Asia.

A negative impact of an adverse TOT shock can also be reflected in a loss of export competitiveness in the home economy, a phenomenon referred to as the Dutch Disease (DD) problem. In economics, the DD problem refers to a situation when a particular sector of the economy gets worse-off following a change in a particular macroeconomic indicator. Barder (2006) refers the DD problem as one that is triggered due to a surge in foreign aid inflow into a developing economy whereby its economic development prospects get marginalized. The Balassa-Samuelson effect theory put forward in the seminal study by Balassa (1964) and Samuelson (1964) explained the DD theory from the perspective of differences in productivities across the traded and non-traded goods sector stimulating Real Exchange Rate (RER) appreciations and making the home economy worse off. In contrast, improvement in the TOT index can incentivize investment in the export sector within the home economy, eventually contributing to the corresponding improvement in the nation's CA balance. The DD problem can be associated with the HLM effect hypothesis in the sense that they both emphasize the fact that a RER appreciation affects the export sector of the home economy affecting its export sector and widening its CA deficit. Although many studies have analyzed the DD problem in the context of external currency inflows into the developing countries (Kallon, 2012 and Uneze, 2011) the linkage between a TOT shock and the DD problem is a field of research that is yet to take-off.

The mystery encapsulating the dynamics of the TOT-CA nexus has sparked the quest in researchers and academicians to investigate this association from different perspectives. Thus, it has been an interesting topic of research, especially for policymakers who have endeavored themselves in rekindling investigation on this relationship in light economic theory and case studies. Although there had been a plethora of studies examining the HLM effect in both developing and developed countries worldwide, it has not been the case in the context of a panel of countries from South and Southeast Asia. This paper attempts to fill this gap in the empirical literature by probing into the validity of the HLM effect with regard to the ‘consumption-smoothing,’ ‘consumption-tilting’ and ‘exchange rates' effects in the context of 14 member countries enlisted under the South Asian Association for Regional Cooperation (SAARC) and Association of Southeast Asian Nations (ASEAN) which include Bangladesh, India, Pakistan, Sri Lanka, Nepal, Singapore, Malaysia, Indonesia, Vietnam, Philippines, Thailand, Myanmar, Cambodia and Brunei Darussalam. The novelty of this paper is further highlighted in the form of evaluating the HLM effect in light of the DD phenomenon. In addition, the linearity of TOT-CA balance association is also examined in this paper while the possible impact of the Asian Financial Crisis (AFC) is also taken into consideration. Causal associations, both in the short and long runs, between the concerned variables are analyzed in the paper. Furthermore, this paper also addresses the region-specific differences, if any, in this nexus. This study can be a cornerstone of appropriate policy-making decisions regarding further bilateral and multilateral trade agreements between these countries. The following questions are specifically addressed in this paper:

1) Does the HLM effect hypothesis hold in the context of panel framework incorporating countries from South and Southeast Asian regions?
2) Is the relationship between TOT and CA balance linear?
3) Does the AFC distort the nexus between TOT and CA balance?
4) What are the directions of causalities between CA balance and its determinants across both the short and long runs?

The remainder of the paper is structured as follows. Section 2 provides an overview of the trends in the changes in TOT indices and CA balances in context of the SAARC and ASEAN countries considered in the paper. This is followed by the review of literature in section 3. Section 4 provides the model specification and attributes of data employed in the paper. Section 5 provides discussion on the methodology of research while section 6 reports the estimated results. Finally, the concluding remarks and possible policy implications are highlighted in section 7.

2. Some Stylized Facts Regarding Transitions in TOT Indices and CA Balances across the SAARC and ASEAN Regions

2.1 Transitions in Terms of Trade Indices

The trends in TOT in context of the five SAARC and the nine ASEAN countries are shown in Table 1. According to statistical evidence regarding the SAARC nations, we can observe that the TOT indices of Bangladesh and Pakistan relatively deteriorated over the years as compared to India and Sri Lanka. Even though Bangladesh experienced the highest TOT value, in history, amongst the SAARC nations reaching a value of 162.26 in 1985, it did not manage to sustain this remarkable achievement for long as the country's TOT persistently portrayed a negative trend from then after. On the other hand, India and Sri Lanka have managed to improve their TOT indices achieving associated TOT growth rates of 45.7% and 25.8%, on average, respectively between 1980 and 2015. In the context of Nepal, the TOT figures depict ups and down from 2000 onwards which implies that the nation's policies are partially effective in improving its TOT index but improvements do not sustain over a longer period of time. The relevant TOT data also shows that all of the five South Asian countries considered in the paper, by and large, have historically encountered difficulties in improving their TOT indices. Moreover, degrees of TOT volatility are comparatively more in Bangladesh and Pakistan relative to India, Sri Lanka and Nepal which is an area of concern for these two economies.

On the other hand, the trends in TOT indices over the years differ across the ASEAN states. Singapore, having a TOT index of around 127 in 1980 has experienced a downward trend since then. However, the country recently has managed to improve its TOT gradually. Thailand portrayed a similar trend in its TOT indices over the years, but its TOT values were relatively better than those of Singapore. In contrast, Malaysia's TOT index improved on average from 71.4 in 1980 reaching 108.5 by the end of 1995. The country's TOT indices were more or less around the 100 mark in the post-2000 period. Amongst all the ASEAN nations, Vietnam and Thailand had a considerable amount of improvements in their TOT indices recording average growth rates of 36.3% and 21.8%, respectively, in between 2000 and 2015. Conversely, Philippines and Cambodia were the worst cases in the ASEAN region as both the nations' TOT indices declined by 31.4% and 24.5%, respectively, after 2000. Although Myanmar had the highest TOT value amongst the ASEAN countries, reaching a staggering figure of 339 in 1985, the country experienced adverse TOT shocks till the early 2000s whereby the TOT index almost reduced by more than three times. However, the post-2000 period was favorable to the nation as it managed to improve its TOT index gradually to some extent.

Table 1: Net Barter TOT (2000=100) from 1980 to 2015

Country	1980	1985	1990	1995	2000	2005	2010	2015
SAARC Countries								
Bangladesh	136.7	162.3	117.4	111.8	100.0	80.5	61.0	66.5
India	71.6	81.0	85.8	108.0	100.0	87.8	93.5	104.4
Pakistan	129.5	116.4	108.7	119.2	100.0	75.2	64.7	60.2
Sri Lanka	87.2	94.1	82.4	99.0	100.0	114.4	109.9	109.7
Nepal	*	*	*	*	100.0	83.4	74.0	85.9
ASEAN Countries								
Singapore	126.8	125.6	116.2	104.3	100.0	82.9	79.5	82.6
Malaysia	71.4	80.2	102.7	108.5	100.0	102.4	97.6	96.6
Thailand	151.6	118.0	118.5	116.0	100.0	96.7	97.8	104.4
Indonesia	*	156.8	94.9	90.4	100.0	107.2	127.6	121.8
Vietnam	*	*	*	*	100.0	112.2	130.5	136.3
Philippines	99.1	80.2	87.4	80.2	100.0	88.6	69.0	68.6
Cambodia	*	*	*	*	100.0	87.9	74.2	75.5
Myanmar	*	339.0	251.9	214.3	100.0	106.6	109.8	111.9

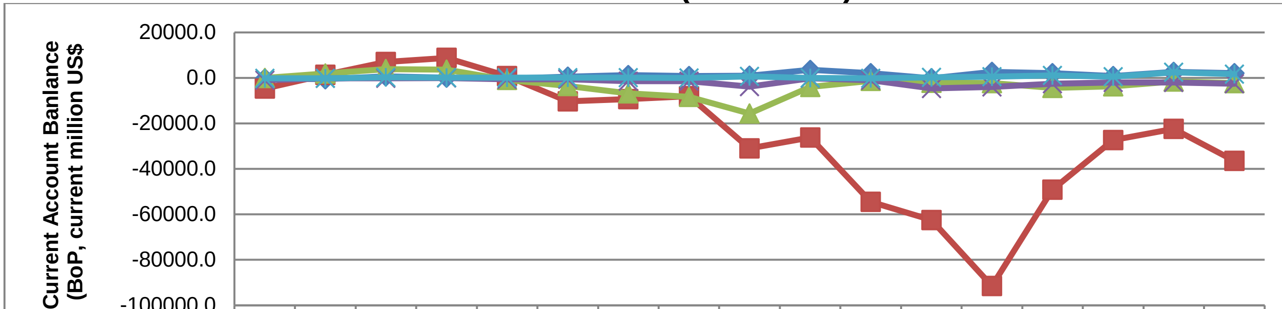
*Note: * denotes missing data.*
Source: World Development Indicators, 2017.

2.2 Historical Trends in the Current Account Balances

Statistical evidence, as portrayed in Figure, 1 depict that amongst the South Asian countries, India has the most volatile and negative CA balance figures. The country has experienced a CA deficit from 2005 onwards with the worst scenario being a sharp fall in the CA balance from about -6251 million US$ in 2011 to around -9147 million US$ in 2013, indicating approximately a 46% worsening of the CA deficit. This implies that the country has been characterized by lack of export competitiveness whereby the bulk of its total trade volumes was dominated by imports. Compared to India, the other four SAARC enlisted nations did relatively well in managing their respective CA balances. Over the course of 2000 and 2016, Bangladesh and Nepal had managed to ensure CA surpluses in most of the years. In contrast, Pakistan witnessed a persistent CA deficit from 2004 onwards while Sri Lanka never managed to attain a positive CA balance during the period.

The CA balances in context of the ASEAN nations are presented in Figure 2. According to the graphical illustration, it can be seen that Singapore has historically been a forerunner in having a relatively superior CA balance compared to the other eight ASEAN countries. From 2000 onwards, the nation always attained a surplus in its CA balance much like Malaysia whose growth in CA surplus peaked in 2008 reaching a surplus figure of almost 39 billion US$. Thailand too had the fortune of experiencing CA surpluses in most of the years between 2000 and 2016, except for 2005, 2012 and 2013 when the nation's CA balance went into deficit. The worst scenario was in 2013 when the deficit aroused to almost 5 billion US$ following a fall in its volume of private expenditure (Bank of Thailand, 2013). The CA balances of Indonesia and Myanmar also display poor trends as these countries faced CA deficits over the last seven to eight years or so. In contrast, Vietnam and Philippines showed opposite trends achieving CA surpluses in recent times. The characteristics of CA balances in Brunei Darussalam and Cambodia also depicted mirror images as Brunei all throughout the post-2000 period displayed a CA surplus while Cambodia never managed to get over its CA deficit.

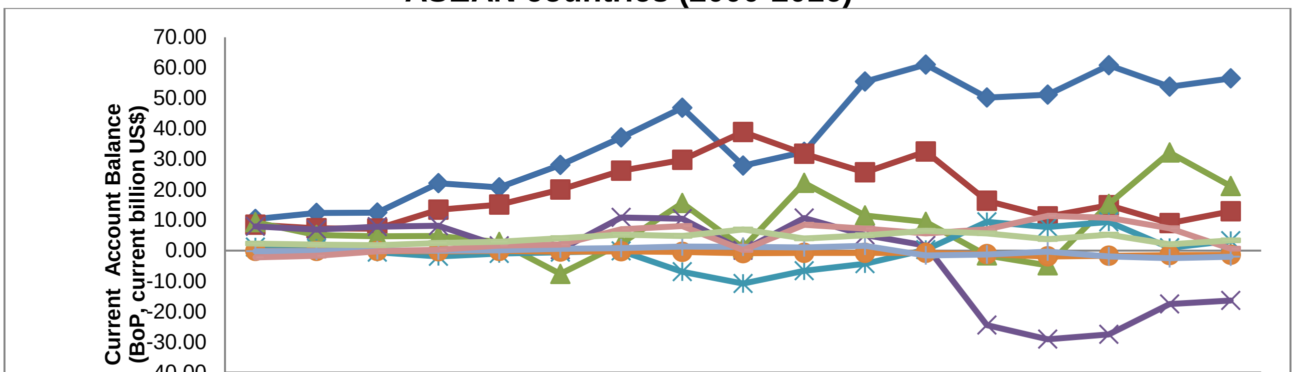
Fig. 1: Current Account Balances (Balance of Payments, current million US$) in SAARC countries (2000-2016)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bangladesh	-305.	-535.	739.3	131.6	-278.	507.7	1196.	856.8	926.2	3556.	2108.	-161.	2575.	2058.	755.8	2686.	2135.
India	-4601	1410.	7059.	8772.	780.2	-1028	-9299	-8075	-3097	-2618	-5451	-6251	-9147	-4912	-2731	-2245	-3651
Pakistan	-85.0	1878.	3854.	3573.	-817.	-3606	-6747	-8301	-1565	-3993	-1354	-2207	-2342	-4416	-3616	-1602	-2219
Sri Lanka	-1043	-215.	-236.	-70.7	-647.	-650.	-1498	-1400	-3885	-214.	-1075	-4615	-4009	-2540	-1987	-2008	-2520
Nepal	-130.	-164.	215.2	180.3	100.0	153.1	150.1	5.7	733.3	21.4	-127.	288.6	576.9	1160.	496.2	2446.	1720.

Source: World Development Indicators, 2017.

Fig. 2: Current Account Balances (Balance of Payments, current billion US$) in ASEAN countries (2000-2016)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Singapore	10.36	12.37	12.40	22.15	20.77	28.10	37.14	46.90	27.83	32.42	55.42	61.04	50.25	51.17	60.82	53.76	56.50
Malaysia	8.49	7.29	7.19	13.38	15.08	19.98	26.20	29.77	38.91	31.80	25.64	32.49	16.32	11.21	14.85	8.96	12.86
Thailand	9.31	5.10	4.65	4.77	2.76	-7.64	2.31	15.58	0.93	22.19	11.49	9.43	-1.62	-4.85	15.29	32.15	21.11
Indonesia	7.99	6.90	7.82	8.11	1.56	0.28	10.86	10.49	0.13	10.63	5.14	1.69	-24.4	-29.1	-27.5	-17.5	-16.3
Vietnam	1.11	0.68	-0.60	-1.93	-0.96	-0.56	-0.16	-6.95	-10.8	-6.61	-4.28	0.24	9.43	7.75	9.36	0.91	3.22
Cambodia	-0.14	-0.09	-0.11	-0.23	-0.18	-0.31	-0.23	-0.42	-0.82	-0.74	-0.80	-0.78	-1.16	-1.94	-1.66	-1.46	-1.43
Myanmar	-0.21	-0.15	0.10	-0.02	0.11	0.58	0.79	1.38	1.25	0.99	1.57	-1.56	-1.26	-0.39	-1.90	-2.49	-2.01
Philippines	-2.23	-1.75	-0.28	0.29	1.63	1.99	6.96	8.07	0.14	8.45	7.18	5.64	6.95	11.38	10.76	7.27	0.60
Brunei	2.29	1.95	1.76	2.48	2.88	4.03	5.23	4.83	6.94	3.98	5.02	6.43	5.68	3.78	5.25	2.07	3.36

Source: World Development Indicators, 2017.

3. Review of Literature

This particular section is subdivided into two parts. The former provides a theoretical framework suggesting the possible impacts of a TOT shock on the CA balance of the home economy which can ultimately lead to the economy being trapped under the DD phenomenon. The latter subsection discusses the existing literature closely associated to the HLM effect hypothesis.

3.1 Theoretical Viewpoints

The focal point of the HLM effect put forward by Harberger (1950) and Laursen and Metzler (1950) was advocated in favor of a positive TOT-CA balance nexus based on three main effects following an exogenous TOT shock in an economy. Firstly, the consumption-smoothing effect refers to a fall in current national income by a value more than the future national income of the home economy whereby a consumption-smoothing behavior of the local people would lead to a decline in the national savings. Thus, the consumption-smoothing effect can be classified as the income effect on savings. The second effect, the consumption-tilting effect occurs when present consumption is given less priority over future consumption as the value of current imports, following a decline in TOT, increases more than the value of imports in future. Thus, the consumption-tilting effect can be referred to as a substitution effect. The second substitution effect is the third of the three effects of a TOT shock which is known as the real exchange rate effect. This effect takes place when RER, following an adverse change in TOT, in the home economy increases due to a rise in the relative prices of tradable goods compared to that of non-tradable goods (Corden and Neary, 1982). According to the HLM effect hypothesis, a negative shock to the TOT index results in a fall in the national savings only if the consumption-smoothing effect dominates the other two effects and eventually lead to a widening of the CA balance, vice-versa. However, the HLM effect of a TOT shock was later challenged by Sachs (1981) who remarked that the nature of TOT-CA balance nexus does not depend on the TOT shock itself but it actually depends on the duration the shock prevails. According to Sachs (1981), only a temporary shock in TOT can result in a fall in national savings, validating the positive relationship between TOT and CA. However, if the shock is a permanent one, then the effect on the CA balance is ambiguous.

3.1.1 The HLM Effect and DD Linkage

Extending the RER effect of a TOT shock, the response of a country's CA balance to an external shock to a country's TOT can be explained by the dynamic behaviors in the home country's Investment-Savings-Monetary Policy (IS-MP) framework and the foreign exchange market equilibrium, as shown in Figure 3 (see appendix). The figure explains the mechanism in which an adverse TOT shock can lead to a RER appreciation in the economy making its export sector worse-off and giving rise to the DD problem. Assuming that deterioration in TOT has occurred in an economy whereby, in line with the HLM effect hypothesis, there will be a decline in the home country's national savings. This can be reflected in a leftward shift in the IS curve (from IS_0 to IS_1). Thus, all things remaining constant, the equilibrium real interest rate is expected to increase (R_0 to R_1). This, in turn, would give rise to disequilibrium in the foreign exchange market of the home country leading to a RER appreciation (from RER_0 to RER_1). An appreciation in a country's RER is synonymous with loss of its export competitiveness, whereby a dampening effect on the overall exports can be expected while the volume of imports may go up simultaneously. Thus, the DD problem can be encountered by the home economy. The overall impact of a decline in the TOT figure can be translated into a worsening of the home country's CA balance, suggesting a positive relationship between the two variables.

3.2 Empirical Findings

Researchers and academicians have historically been fascinated by the dynamics cohering the TOT-BA balance nexus whereby the responses of TOT indices following shocks in TOT indices were analyzed using multiple approaches. However, ambiguous results in existing literature suggest the unpredictability of the nature of this association.

3.2.1 The Harberger-Laursen-Metzler Literature

Lukáčik *et al.* (2016) analyzed the impacts of TOT shocks on the Slovakian economy using quarterly data across 1997 and 2014. A structural vector autoregressive model was employed in the paper where trade balance was expressed as a function of TOT and other controlled variables. The authors concluded a negative relationship between TOT and CA balance, validating the remarks made in the seminal paper by Obstfeld (1982) and Svensson and Razin (1983). The authors also asserted that the magnitude of the HLM effect dies out as the shock in the TOT becomes persistent with time.

The HLM effect was exclusively investigated in the context of Pakistan by Idrees and Tufail (2012). The study employed Recursive Vector Autoregressive (RVAR) tools to empirically probe into the TOT-CA balance nexus using annual time series data from 1980 to 2009. A trivariate model was considered in the paper where CA was expressed in terms of TOT and real income in the economy of Pakistan. The results confirmed a negative relationship between TOT and CA responses, implying the absence of the HLM effect in the country. In addition, the authors also put forward the notion that a TOT improvement in Pakistan deteriorated the economy of Pakistan by stimulating a fall in the country's national income.

Aquino and Espino (2013) examined the fluctuations in TOT indices and CA balances in context of a small open economy, Peru employing Vector Autoregressive (VAR) analyses. The period of the study spanned across 1950 and 2009. ADF, Phillips-Perron and Ng-Perron unit root tests were used along with impulse response analysis and variance decomposition techniques. The empirical model used in the paper comprised of CA balance of Peru being the dependent variable while TOT, export prices, import prices, investments and savings were referred to as the explanatory variables. The study, in light of the findings, advocated in favor of a positive TOT-CA balance relationship by concluding that an unexpected and permanent TOT improvement in Peru resulted in an increase in national savings leading to a corresponding improvement in the country's CA balance.

The HLM effect was revisited in a paper by Bouakez and Kano (2008) from the perspective of Australia, Canada and the United Kingdom. The analysis was conducted using the Present Value Model (PVM) of CA using quarterly time series data from 1972Q1 to 2001Q4 for Australia, from 1962Q2 to 2001Q2 for Canada and from 1971Q1 to 2001Q4 for the United Kingdom. In addition, the authors also augmented the PVM model separately incorporating interest rate and exchange rate data. The results confirmed that in general, a TOT change is ineffective in explaining CA balance movements in all the three countries. Moreover, in context of Canada and Australia, the PV< model was even rejected. Thus, in light of the empirical evidence in the study, the authors clearly stood to stand against the HLM effect taking place in these countries.

The association between a TOT shock and the CA balance in Greece was investigated in a paper by Bitzis *et al.* (2008). The authors accumulated quarterly time series data from 1995Q1 to 2006Q4 and resorted to using Johansen cointegration and Error Correction Modeling (ECM) methods to draw conclusions on the determinants of the Greek CA deficit. According to the findings, a negative relationship between TOT and the CA deficit in the Greek economy was established. This paper actually pressed on the fact that an increase in domestic demand following a TOT improvement led to a reduction in the CA deficit in Greece, validating the positive relationship between TOT and CA balance asserted in the HLM effect hypothesis.

3.2.2 The Dutch Disease Literature

The existing literature provides nominal examples linking TOT shocks to DD problem in the home economy. In a study by Nedeljkovic *et al.* (2015), the DD problem in Indonesia was put forward accusing the nation's TOT shock to be the main factor leading to a sizable drop in the total volume of exports. Indonesia, which once was a trade surplus economy, faced a positive shock in its TOT index pushing export prices up. The shock lasted till 2014, attributing to loss of the nation's export competitiveness whereby export volumes were axed and replaced by imports; thus widening the country's CA deficit.

Many studies have also linked unanticipated and permanent shocks in a country's TOT index to appreciation in the RER which eventually triggers the DD problem by hampering export growth in the home economy. In a study by Thorbecke and Kato (2012), the authors made an attempt to relate Germany's RER depreciation to the surge in its export volume following the nation's devaluation of local currency after 2000. The study incorporated Johansen maximum likelihood and Dynamic Ordinary Least Squares (DOLS) estimation techniques along with panel DOLS estimation methods. Thus, the study concluded stating a positive relationship between the RER and exports which also implies a positive relationship between RER and net exports as well. Thus, in line with the findings of Thorbecke and Kato (2012), it can be concluded that a negative shock in TOT stimulating a RER appreciation can dampen export growth in the home economy leading to the DD problem.

Coudert *et al*. (2008) also examined how TOT movements explain changes in RER in context of a panel of 52 commodity exporting and 16 oil exporting economies. The authors aimed to explain the long-run relationships between the Real Effective Exchange Rate (REER) in the countries with respect to commodity TOT and TOT alone using relevant data from 1980 to 2007. The authors employed panel unit root test, Granger causality tests, impulse response functions and DOLS estimation techniques to estimate the relationship between REER and its fundamentals. The results reveal that in general REER and commodity TOT move in the same direction implying a positive association between them. Thus, the results coincide with the theoretical framework suggesting that a decline in the TOT index would appreciate the RER in the home country causing the DD problem by hindering the growth of its exports.

A possible limitation of the aforementioned papers lies in the understanding that these studies have primarily focused on the correlation between TOT shocks and the aftermath without emphasizing on the corresponding causal associations. This paper would fill this gap by analyzing both the short and long run causal relationships in order to provide robustness to the correlation estimates existing in literature.

4. Model Specification and Attributes of Data

The empirical model employed in this paper is an extension of the model used by Idrees and Tufail (2012) to investigate the existence of the HLM effect in Pakistan. The model was augmented to incorporate relevant controlled variables into the regression space which was a limitation of the original model. In this paper, CA balance was expressed as a function of TOT shocks and other determinants of CA transitions along with some dummy variables to incorporate their impacts on the TOT-CA nexus. The core regression model is given as follows:

$$CA_{it} = \beta_0 + \beta_1 TOT_{it} + \beta_2 RER_{it} + \beta_3 GDPPC_{it} + \beta_4 NX_{it} + \varepsilon_{it} \quad \text{.........(i)}$$

where the subscript i refers to the cross-section (country) and t refers to the time (year). CA, TOT, RER, GDPPC, NX and ε refer to current account balance, terms of trade, real exchange rate, gross domestic product per capita, net exports and error term, respectively. Data of all the variables are considered from 2000 to 2016 and accumulated from the World Development Indicators, WDI (2017). CA is measured in terms of current US$ while NX is measured in terms of net barter terms of trade index (base year 2000=100). A positive relationship between TOT and CA balance can be hypothesized. RER is considered as a proxy to denote the exchange rate volatility in real terms and is calculated using own calculation incorporating nominal exchange rate, consumer price index of each country and consumer price index of USA data. A positive RER-CA nexus can be expected since a fall in the TOT index can appreciate RER whereby exports can go down while imports are likely to be boosted. GDPPC provides a measure of the level of economic growth in the economy. Both GDPPC and NX are measured in terms of current US$ as well.

Moreover, in order to investigate the linearity in the relationship between TOT and CAD, a squared term of the TOT (i.e. TOT^2) variable is introduced:

$$CA_{it} = \beta_0 + \beta_1 TOT_{it} + \beta_2 TOT_{it}^{\ 2} + \beta_3 RER_{it} + \beta_4 GDPPC_{it} + \beta_5 NX_{it} + \varepsilon_{it} \quad \text{.......... (ii)}$$

This paper also considers the possible impact of the AFC, which initiated in 2007 and spanned over 2008 and 2009, on the TOT-CA nexus by incorporating a dummy variable

(DUM) and used it as an interaction term with the TOT variable. The dummy variable has a value of 1 denoting the existence of the AFC in the years 2007, 2008 and 2009 while for all the other years it has a value of 0. The third model is given by:

$$CA_{it} = \beta_0 + \beta_1 TOT_{it} + \beta_2 TOT_{it}^{\ 2} + \beta_3 (TOT * DUM)_{it} + \beta_4 RER_{it} + \beta_5 GDPPC_{it} + \beta_6 NX_{it} + \varepsilon_{it} \ \ldots\ldots\ldots \text{(iii)}$$

Finally, model (iv) is used in order to investigate whether a shock in the TOT index gives rise to the DD problem by axing the volume of imports and replacing it with imports, eventually affecting the net exports of the home economy. The basic idea behind this empirical model is the fact that there might be a possible linkage between the HLM effect and the DD problem whereby an adverse TOT shock can lead to both deteriorations of the CA balance and also the net exports of the home economy. The DD equation is given by:

$$NX_{it} = \alpha_0 + \alpha_1 TOT_{it} + \alpha_2 (TOT * DUM)_{it} + \alpha_3 RER_{it} + \varepsilon_{it} \qquad \ldots\ldots\ldots\ldots\ldots \text{(iv)}$$

All the aforementioned four equations were separately considered for the full panel of fourteen nations and also for sub-panels classified as per the regional association each of the countries belongs to. The SAARC subpanel includes 5 South Asian nations like Bangladesh, India, Pakistan, Sri Lanka and Nepal. On the flip side of the coin, the ASEAN panel comprises of the remaining nine countries including Singapore, Malaysia, Indonesia, Thailand, Cambodia, Myanmar, Philippines, Vietnam and Brunei Darussalam. Relevant annual time series data in a panel framework, ranging from 2000 to 2016, is accumulated from different sources mentioned earlier.

5. Methodology

This paper incorporates a wide array of panel methodologies to estimate robust findings. An elaborated description of the econometric tools hired in this paper is discussed in this section. At first, the entire data set incorporated in the paper is tested for the presence of unit roots using a couple of panel test of stationarity.

5.1 The Levin, Lin and Chu (LLC) Test

The LLC test (2002) is a first generation panel unit root test that hinges on the assumption that unit root is a homogeneous process. The term 'homogeneous' denotes that the test is estimated assuming a common Autoregressive (AR) structure for all the cross-sectional units in the form of countries considered in the panel. Let us consider the Augmented Dickey-Fuller (ADF) regression model below to get a clear understanding of the LLC test:

$$\Delta y_{it} = \alpha_i y_{i,t-1} + \sum_{L=1}^{\rho_i} \theta_{iL} \Delta y_{i,t-L} + \delta_{mi} d_{mt} + \epsilon_{it} \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(v)}$$

where Δy_{it} = $y_{i,t-1}$, αi = $-(1-\rho_i)$, d_{mt} is the vector of deterministic variables, $\delta_{mi}$is the corresponding vector of coefficients for model *m* and ε_{it} is a white noise error term for *i* = 1, …, N cross-sections and *t* = 1, …, T time periods. The homogeneous unit root assumption implies that $\alpha_i = \alpha$ for all *i.* The LLC test null hypothesis is that each individual series of the panel cross-sections contain a unit root (H_0: α = 0 for all *i*). The null is tested against the alternative hypothesis that the individual series does not contain a unit root (H_1: α ≠ 0 for all *i*). The probability value of the estimated *t*-statistic for each of the series provides the result of stationarity with the rule of thumb being if the probability value, with respect to a particular series across all cross-sections, is below 10% level of significance, then the null hypothesis can be rejected implying the series to be stationary. Due to the limitations of the LLC test in the form of being heavily dependent on the assumption of homogeneous unit root across all the cross-sections and being more restrictive in the sense that is assumes all cross-sections to have or not have a unit root which needs ρ to be homogeneous across all *i,* the other panel unit root tests are conducted as well.

5.2 The Im, Pesaran and Shin (IPS) Test

Unlike the LLC test for panel unit root which assumes a homogeneous unit root process, the IPS test (2003) allows for a heterogeneous value of α_i. The IPS suggests a unit root testing method based on averaging individual unit root test statistics. The basic equation for IPS is as follows:

$$\Delta y_{i,t} = \propto_i + \rho_i y_{i,t} + \sum_{j=1}^{\beta} \varphi_{ij} \Delta y_{i,t-j} + \epsilon_{i,t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(vi)}$$

where $y_{i,t}$ represents each of the variables under consideration in the model, α_i is the individual fixed effect, and β is selected to make the residuals uncorrelated over time. The null hypothesis is that each individual series of the panel cross-sections contain a unit root (H_0: α = 0 for all *i*) which is tested against the alternative hypothesis is that for each individual series at least one of the cross-section does not contain a unit root (H_1: $\alpha_1 < 0$, for *i* = 1, 2, …, N_1; H_1: $\alpha_1 = 0$, for *i* = N_1 + 1, N_1 +2, …, N). The probability value of the estimated *w*-statistic for each of the series provides the result of stationarity with the rule of thumb being if the probability value, with respect to a particular series across all cross-sections, is below 10% level of significance, then the null hypothesis can be rejected implying the series to be stationary.

5.3 The Breitung Test

The Breitung (2000) test is referred to be second generation panel unit root test that studies the local power of the LLC and IPS test statistics and finds them to be very sensitive to the inclusion of the individual-specific trends. This is because the LLC and IPS tests employ a bias correction. The Breitung test statistic avoids the bias adjustment and has been found to have the capability that is greater than the LLC test, where the capability is the probability of rejecting a false null hypothesis. The Breitung test statistic is obtained going through similar steps to the LLC, till obtaining the residuals, where LLC uses $\Delta y_{i,\,t-L}$ and d_{mt} both, the vector deterministic variables, but the Breitung test uses only the $\Delta y_{i,\,t-L}$ excluding the d_{mt}. Similarly to the LLC test, the Breitung test assumes that all the panels in the paper have a common AR parameter. The null hypothesis is that each of the series is non-stationary (H_o: α = 0 for all *i*) which is tested against an alternative hypothesis is that each of the series is stationary (H_1: α ≠ 0 for all *i*). The probability value of the estimated *t*-statistic for each of the series provides the result of stationarity with the rule of thumb being if the probability value, with respect to a particular series across all cross-sections, is below 10% level of significance, then the null hypothesis can be rejected implying the series to be stationary.

5.4 Maddala and Wu Test

The Maddala and Wu (1999) panel unit root test, a first generation non-stationarity test, is actually a Fisher-type test combining the probability values from unit root tests for each cross-section in the panel. In similarity with the IPS test, the heterogeneity of the unit root process is considered in this test. This can be shown using the following equation:

$$P = -2\sum_{i=1}^{N} ln\, p_i \qquad \text{.. (vii)}$$

where p_i is the probability value from any individual unit root test for any cross-section and *P* is distributed as Chi-square with 2N degrees of freedom where N is the total number of cross-sections considered in the panel. The probability values are obtained from the estimated Augmented Dickey-Fuller (ADF)-Fisher and the Phillips-Perron (PP)-Fisher Chi-square test statistics. The null hypothesis is that each individual series of the panel cross-sections contain a unit root (H_0: p_i = 1 for all *i*) which is tested against the alternative hypothesis is that for each individual series at least one of the cross-section does not contain a unit root (H_1: p_i < 1). The probability values of the estimated ADF-Fisher Chi-square and PP-Fisher Chi-square statistics for each of the series provide the result of stationarity with the rule of thumb being if the probability value, with respect to a particular series across all cross-sections, is below 10% level of significance, then the null hypothesis can be rejected implying the series to be stationary. Maddala and Wu (1999) find that for high values of T and N the Maddala and Wu-Fisher-test is chosen over the IPS test as size distortions are smaller at comparable power. For smaller values of T and N, however, IPS and LLC seem to be preferable over Maddala and Wu-Fisher-tests.

5.5 Hadri Test

Unlike the aforementioned panel unit root tests, the Hadri (2000) test is based on the null hypothesis of stationarity. The test is an extension of the stationarity test developed by Kwiatkowski *et al.* (1992) in the context of time series study. The test is a first generation panel unit root test and considers a residual-based Lagrange multiplier test for the null hypothesis that the individual series are stationary around a deterministic level or around a deterministic trend (H_0: $\sigma_{it}^2 = 0$, for all *i*), tested against an alternative hypothesis of the presence of a unit root in the panel data of each series (H_1: $\sigma_{it}^2 > 0$, for all *i*). The probability values from the estimated Hadri z-statistic and the estimated Heteroskedasticity consistent Hadri z-statistic are considered to draw conclusions on the stationarity of all the series considered. If the probability values are more than 10%, meaning that the null hypothesis cannot be rejected at the conventional 10% level of significance, imply the presence of stationarity in the panel data. The panel unit root tests were followed by the fixed effects panel estimation techniques to estimate the elasticities of the explanatory variables with respect to the dependent variable CA balance.

5.6 Fixed Effects Panel Estimation Techniques

Given the heterogeneity of the data set in terms of countries belonging to different income groups and levels of development, the fixed effects panel estimation techniques are considered to be appropriate, over the pooled Ordinary Least Squares (OLS) methods, in this paper. In contrast to the pooled OLS estimation that provides a common constant across all cross sections, the fixed effects estimation technique allows for cross section-specific constants. The fixed effects estimator can also be classified as the Least-Squares Dummy Variables (LSDV) since it incorporates a dummy variable for each cross-section to include different constants (Asteriou and Hall, 2007). A simple fixed effects model can be given by:

$$Y_{it} = A_i + \partial_1 X_{1it} + \partial_2 X_{2it} + \cdots + \partial_3 X_{kit} + U_{it} \quad \text{(viii)}$$

where Y and X are dependent and independent variables, respectively. The subscripts 'i' denotes a particular cross section or country and can take any value from 1 to N (i.e. i = 1, 2, …, N). The other subscript 't' is used to denote the time period (t = 1, 2, …, T). The constant term is given by A which varies according to the value of i. This model can be rewritten in matrix form as well:

$$Y = DA + X\partial' + U \quad \text{(ix)}$$

where D is the dummy variable that allows different cross section-specific estimates for each of the constant term.

The appropriate applicability of a fixed effects estimation method over a random effects estimation method can be confirmed by the results from the Hausman (1978) test. The null hypothesis used in the test asserts that the random effects model is appropriate, which is tested against the alternative hypothesis asserting the fixed effects model to be more appropriate. Under this test, if the estimated value of the Chi-squares statistic is greater than the associated critical value then the null hypothesis can be rejected validating the acceptability of the fixed effects estimation method, vice-versa. All the four models (i, ii, iii and iv) were tested using the Hausman test before choosing the fixed effects estimation technique in this paper. The panel cointegration tests are then carried out to detect any long run cointegrating equations in the regression models.

5.7 Pedroni Cointegration Test

The Pedroni (2004) test of cointegration is a residual-based test. It employs the Engle-Granger (1987) two-step cointegration tests that examine the residuals of a spurious regression performed using variables that are found to be stationary at the first differences, I(1). It uses seven test statistics that are tested for the null hypothesis of no cointegration against the alternative hypothesis of cointegration for panels in which the estimated slope coefficients are permitted to vary across individual cross-sections of the panels. Thus, these statistics allow for the heterogeneous fixed effects and deterministic trends and also for heterogeneous short-run dynamics. In the context of a panel of N countries, M number of regressors (X_m) across T time period, the Pedroni test considers the following regression model:

$$y_{it} = \alpha_i + \gamma_{it} + \sum_{m=1}^{M} \beta X_{m,it} + \epsilon_{it}, \qquad for\ t = 1, \dots, T; i = 1, \dots, N; m = 1, \dots, M \quad \text{..... (x)}$$

where the variables y_{it} and $X_{m,it}$ are assumed to be integrated of the same order I(d), for each cross-sectional unit i in the panel. The parameters αi, γ_i and $\beta_{m,i}$ account for heterogeneous fixed effects, deterministic trends and heterogeneous slope coefficients respectively. E_{it} are estimated residuals indicating deviations from the long-run relationship. In order to carry out the cointegration test, Pedroni conducts unit root tests on the residuals as follows:

$$\epsilon_{it} = \gamma_i \varepsilon_{i,t-1} + \omega_{it} \qquad \text{.. (xi)}$$

The tests are classified into two categories. The first set of tests is the panel cointegration based on the within-dimension approach which contains eight panel statistics (v-statistic, ρ-statistic, ADF-statistic, PP-statistic and the weighted statistics of these four panel statistics) that pool the AR coefficients across different cross-sections for the unit root tests on the estimated residuals. Accordingly, these panel statistics are tested for the null hypothesis of no cointegration (H_0: γ_i=1 for all i) against the alternative hypothesis of cointegration in the panel (H_1: γ_i= γ<1 for all i), which assumes a homogeneous γ across all cross-sections. If the null hypothesis is rejected in these panel statistics case then the variables are said to be cointegrated for all the cross-sections in the panel (Ramirez, 2006).

The second set of tests is the group cointegration tests based on a between-dimension approach that includes three group panel statistics (ρ-statistic, ADF-statistic and PP-statistic). These statistics simply average the individually estimated coefficients for each cross-section, i. For the between-dimension approach, the null hypothesis of no cointegration (H_0: γ_i=1 for all i) is tested against the alternative hypothesis (H_1: γ_i= γ<1 for all i), which allows for heterogeneity in the AR coefficients. If the null hypothesis is rejected in these group panel statistics case then the variables are said to be cointegrated for at least one cross-section in the panel (Ramirez, 2006).
As a rule of thumb, if the majority of the eleven test statistics considered in the Pedroni test can be used to reject the null at 10% level of significance then it is said that the variables considered in the panel study are cointegrated in the long run and vice-versa.

5.8 The Johansen Fisher Panel Cointegration Test

The Johansen Fisher panel cointegration test proposed by Maddala and Wu (1999) is a panel version of the individual Johansen (1998) cointegration test. The Johansen (1998) procedure is known to provide a unified framework for estimation and testing of cointegration relations in the context of VAR error correction models. It basically tells us whether or not the variables are associated in the long run. This paper estimates an Unrestricted Vector of Autocorrelation of the following form for this purpose:

$$\Delta x_t = \alpha + \theta_1 \Delta x_{t-1} + \theta_2 \Delta x_{t-2} + \theta_3 \Delta x_{t-3} + \cdots\cdots + \theta_{k-1} \Delta x_{t-k+1} + \theta_k \Delta x_{t-k} + u_t \quad \text{………… (xii)}$$

where Δ is the difference operator; x_t is a (n x 1) vector of non-stationary variables (in levels); and U_t is the (n x 1) vector of random errors. The matrix θ_k contains the information on the long-run relationship between variables, for instance, if the rank of $\theta_k = 0$, the variables are not cointegrated. On the other hand if rank (usually denoted by r) is equal to 1, there exists one cointegrating vector and finally if $1 < r < n$, there are multiple cointegrating vectors. Johansen (1990) derive two tests for cointegration, namely the trace test and the maximum Eigenvalue test. The trace statistic test evaluates the null hypothesis that there are at most r cointegrating vectors whereas the maximal Eigenvalue test, evaluates the null hypothesis that there are exactly r cointegrating vectors in x_t. According to cointegration analysis, when two variables are cointegrated then there exists at least one direction of causality.

Johansen (1998) suggests a method for both determining how many cointegrating vectors there are and also estimating all the distinct relationships. Thus, it can be viewed as a multivariate generalization of the Dickey-Fuller test. Similarly, the Johansen Fisher panel cointegration test is founded on the same principles underpinning the Fisher ADF panel unit root test and aggregates the probability values of individual Johansen maximum eigenvalue and trace statistics. If p_i is the probability value of from an individual cointegration test for cross-section *i*, under the null hypothesis of no cointegration then the test statistic for the panel is given by:

$$-2 \sum_{i=1}^{N} ln\, p_i \sim \times X_{2N}^2 \quad \text{………………………………………… (xiii)}$$

The value of the Chi-square statistic is based on the MacKinnon *et al.* (2001) probability values for Johansen's (1998) cointegration trace test and maximum eigenvalue test.
The panel causality tests are finally conducted to identify the direction of causalities, if any, between the variables employed in this paper. It is to be remembered that the presence of cointegration between the variables implies the existence of a causal association between the variables across the short run as well as the long run. The panel VECM approach provides the short run causal associations while the Granger causality test provides the pair-wise long-run causal association between the variables considered in the paper.

5.9 Panel Vector-Error Correction Model Approach to Causality

A Vector Error-Correction Model (VECM) is a restricted Vector Autoregressive (VAR) model structured to employ non-stationary series that are known to be cointegrated. It is restricted in the sense that the VECM has cointegrating relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the Error Correction Term (ECT) which provides the pace at which any deviation from the long-run equilibrium in the previous lag is corrected in the next lag through a series of partial short-run adjustments. This is referred to as the Error Correction Mechanism (ECM).

Engle and Granger (1987) showed that a VECM is an appropriate method to model the long-run as well as short-run dynamics among the cointegrated variables. However, in context of a multivariate regression analysis, the VECM approach is preferred to provide only the short-run causality among the variables. Causality inferences in the multi-variate framework are made by estimating the parameters of the following VECM equations:

$$\Delta Y = \alpha + \sum_{i=1}^{m} \beta i \Delta Y_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta X_{t-j} + \sum_{k=1}^{0} \delta \Delta M^s + \sum_{l=1}^{p} \zeta \Delta N + \theta Z_{t-1} + \varepsilon_t \qquad \text{(xiv)}$$

$$\Delta X = a + \sum_{i=1}^{m} b_i \Delta Y + \sum_{j=1}^{n} c_j \Delta X_{t-j} + \sum_{k=1}^{0} d \Delta M^s + \sum_{l=1}^{p} e \Delta N + f Z_{t-1} + \xi_t \qquad \text{(xv)}$$

z_{t-1} is the error-correction term which is the lagged residual series of the cointegrating vector. The error-correction term measures the deviations of the series from the long run equilibrium relation. For example, from equation (i), the null hypothesis that X does not Granger-cause Y is rejected if the set of estimated coefficients on the lagged values of X is jointly significant. Furthermore, in those instances where X appears in the cointegrating relationship, the hypothesis is also supported if the coefficient of the lagged error-correction term is significant. Changes in an independent variable may be interpreted as representing the short run causal impact while the error-correction term provides the adjustment of Y and X toward their respective long-run equilibrium. Thus, the VECM representation allows us to differentiate between the short- and long-run dynamic relationships. The Chi-Square test statistic is used to determine the short run causalities between pairs of variables in the model.

In the context of a panel of N countries, three regressors (X, Y and Z) across T time period, the VECM model can be given by:

$$\begin{bmatrix} \Delta X_{it} \\ \Delta Y_{it} \\ \Delta Z_{it} \end{bmatrix} = \begin{bmatrix} \omega_{1i} \\ \omega_{2i} \\ \omega_{3i} \end{bmatrix} + \sum_{k=1}^{q} \begin{bmatrix} \alpha_{11ik} & \alpha_{12ik} & \alpha_{13ik} \\ \alpha_{21ik} & \alpha_{22ik} & \alpha_{23ik} \\ \alpha_{31ik} & \alpha_{32ik} & \alpha_{33ik} \end{bmatrix} \begin{bmatrix} \Delta X_{it-k} \\ \Delta Y_{it-k} \\ \Delta Z_{it-k} \end{bmatrix} + \begin{bmatrix} \gamma_{1i} \\ \gamma_{2i} \\ \gamma_{3i} \end{bmatrix} ECT_{it-1} + \begin{bmatrix} \mu_{1it} \\ \mu_{2it} \\ \mu_{3it} \end{bmatrix} \qquad \text{…. (xvi)}$$

where Δ denotes first difference transformation of the variables.

In addition to estimating the short run causality between the variables considered in the model, the VECM approach is also used to calculate the Error Correction Term (ECT) which shows the pace at which any deviation from the equilibrium in the previous lag is adjusted in the following lag. In order for the ECT to be considered, it must be both negative and statistically significant at 10% level of significance.

5.10 Panel Granger Causality Test

The panel Granger causality test is similar to the Granger causality test in the contest of individual time series introduced by Granger (1969, 1980, and 1988). It is one of the important matters that has been much studied in empirical macroeconomics and empirical finance. The presence of non-stationarity can lead to ambiguous or misleading conclusions in the Granger causality tests (Engle and Granger, 1987). Only when the variables are cointegrated, it is possible to deduce that a long run relationship exists between the non-stationary time series. When we take y and x as the variables of interest, then the Granger causality test (Granger, 1969) determines whether past values of y add to the explanation of current values of x as provided by information in past values of x itself. If previous changes in y do not help explain current changes in x, then y does not Granger cause x. In a similar way, we can examine if x Ganger causes y just be interchanging them and carrying out this process again. There could be four probable outcomes: (i) x Granger causes y (ii) y Granger causes (iii) Both x and y granger causes the other and (iv) neither of the variables Granger causes the other. In this paper, the causality tests among all the concerned variables are conducted. For this the following set of equations is estimated:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \cdots\cdots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \cdots\cdots + \beta_l y_{t-l} + u_t \quad \text{......... (xvii)}$$

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots\cdots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \cdots\cdots + \beta_l x_{t-l} + v_t \quad \text{........ (xviii)}$$

The above set of equations is considered for all possible pairs of (x, y) series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis.

6. Results

The unit root test results show that all the variables employed in this paper are stationary at their first differences, I(1), for all the three panels. The absence of unit root in the data set, therefore, nullifies the regression being spurious. Results from the unit root tests are given in Table 2, 3 and 4.

Table 2: Panel Unit Root Test Results for Full Panel (Lag=8)

Panel unit root tests at 1st difference, I(1)								
	Levin, Lin & Chu	Im, Pesaran & Shin	Breitung	Maddala and Wu		Hadri		
Variable	t-stat	W-stat.	t-stat.	ADF--Fisher Chi-Square Stat.	PP-Fisher Chi-Square Stat.	Hadri Z-stat	Heter. Consistent Z-Stat.	Decision
CA	-11.648*	-9.657*	-6.210*	123.415*	187.514*	3.370*	14.985*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
TOT	-12.546*	-9.715*	-3.900*	124.271*	172.999*	7.905*	11.211*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
RER	-8.474*	-4.844*	-2.798*	70.344*	136.151*	10.318*	14.000*	Stationary
	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	
GDPPC	-8.653*	-3.707*	-4.384*	56.013*	71.213*	4.611*	9.176*	Stationary
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	
NX	-9.882*	-6.861*	-6.112*	91.548*	146.743*	5.068*	17.719*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
TOT^2	-13.712*	-10.216*	-3.657*	129.771*	176.309*	12.046*	10.653*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
DUM	-0.205	-5.435*	-12.140*	73.072*	73.072*	-0.287	-0.287	Stationary
	(0.419)	(0.000)	(0.000)	(0.000)	(0.000)	(0.613)	(0.613)	
TOT*DUM	-5.329*	-5.852*	-12.506*	78.473*	76.611*	0.070	-0.324	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.472)	(0.627)	

*Notes: Considering trend and intercepts. The probability values are given in the parenthesis. *, ** & *** denote statistical significance at 1%, 5% and 10% levels; Automatic maximum lag and lag length selections based on Schwarz Information Criteria (SIC).*

Table 3: Unit Root Test Results for South Asian Panel (Lag=8)

Variable	Levin, Lin & Chu	Im, Pesaran & Shin	Breitung	Maddala and Wu		Hadri		Decision
	Panel unit root tests at 1st difference, I(1)							
	t-stat	W-stat.	t-stat.	ADF--Fisher Chi-Square Stat.	PP-Fisher Chi-Square Stat.	Hadri Z-stat	Heter. Consistent Z-Stat.	
CA	-8.826*	-7.765*	-4.993*	56.669*	74.739*	1.333***	7.793*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.091)	(0.000)	
TOT	-7.499*	-5.165*	-3.535*	40.444*	74.600*	5.435*	8.005*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
RER	-3.762*	-2.993*	-2.196**	27.077**	71.207*	5.358*	11.194*	Stationary
	(0.000)	(0.001)	(0.014)	(0.002)	(0.000)	(0.000)	(0.000)	
GDPPC	-5.024*	-2.381**	-2.796**	21.205**	32.629*	6.237*	7.096*	Stationary
	(0.000)	(0.020)	(0.003)	(0.020)	(0.000)	(0.000)	(0.000)	
NX	-5.746*	-4.249*	-4.353*	33.829*	49.294*	2.055**	7.620*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.020)	(0.000)	
TOT^2	-8.095*	-5.733*	-3.136*	44.289*	74.308*	5.221*	7.356*	Stationary
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	
DUM	-0.123	-3.248*	-7.221*	26.097**	26.097**	-0.172	-0.172	Stationary
	(0.451)	(0.001)	(0.000)	(0.004)	(0.004)	(0.568)	(0.568)	
TOT*DUM	-4.031*	-4.253*	-8.184*	32.915*	32.9158	-0.440	-0.437	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.670)	(0.669)	

*Notes: Considering trend and intercepts. The probability values are given in the parenthesis. *, ** & *** denote statistical significance at 1%, 5% and 10% levels; Automatic maximum lag and lag length selections based on Schwarz Information Criteria (SIC).*

Table 4: Unit Root Test Results for ASEAN Panel (Lag=8)

Variable	Levin, Lin & Chu	Im, Pesaran & Shin	Breitung	Maddala and Wu		Hadri		Decision
	Panel unit root tests at 1st difference, I(1)							
	t-stat	W-stat.	t-stat.	ADF--Fisher Chi-Square Stat.	PP-Fisher Chi-Square Stat.	Hadri Z-stat	Heter. Consistent Z-Stat.	
CA	-7.716*	-6.281*	-4.279*	66.747*	112.775*	4.787*	12.881*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
TOT	-10.082*	-8.283*	-2.439*	83.827*	98.402*	6.212*	8.016*	Stationary
	(0.000)	(0.000)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	
RER	-7.769*	-3.809*	-2.023**	43.266*	64.744*	8.273*	9.117*	Stationary
	(0.000)	(0.000)	(0.022)	(0.001)	(0.000)	(0.000)	(0.000)	
GDPPC	-7.099*	-2.845*	-3.396*	34.08***	38.584*	3.692*	6.156*	Stationary
	(0.000)	(0.002)	(0.000)	(0.100)	(0.003)	(0.000)	(0.000)	
NX	-8.050*	-5.389*	-4.453*	57.716*	97.449*	9.937*	16.420*	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
TOT^2	-11.080*	-8.479*	-2.341*	85.482*	102.001*	9.799*	7.804*	Stationary
	(0.000)	(0.000)	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)	
DUM	-0.164	-4.358*	-9.720*	46.975*	46.975*	-0.230	-0.230	Stationary
	(0.435)	(0.000)	(0.000)	(0.000)	(0.000)	(0.591)	(0.591)	
TOT*DUM	-3.348*	-4.136*	-9.536*	45.558*	43.695*	0.265	-0.078	Stationary
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.395)	(0.531)	

*Notes: Considering trend and intercepts. The probability values are given in the parenthesis. *, ** & *** denote statistical significance at 1%, 5% and 10% levels; Automatic maximum lag and lag length selections based on Schwarz Information Criteria (SIC).*

Following the unit root tests, the fixed effects panel estimation tools are used to estimate the relationship between the variables. All the four models in the paper are separately estimated with regard to all the three panels. Table 5 presents the estimated coefficients in context of model (i).

Table 5: Panel Fixed Effects estimation of model (i)

Variables	Dependent Variable: CA					
	Full Panel		SAARC Panel		ASEAN Panel	
	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
TOT	-62552521*	0.001	-97481451*	0.005	-19826965	0.384
RER	393763.4***	0.092	-22260437	0.667	-520058.4*	0.039
GDPPC	122136.1**	0.068	1194211	0.329	-89047.32	0.335
NX	0.707491*	0.000	0.020878*	0.000	0.834518*	0.000
	R^2 = 0.947		R^2 = 0.964		R^2 = 0.929	
	Adjusted R^2= 0.941		Adjusted R^2 = 0.960		Adjusted R^2 = 0.922	

*Notes: * , ** and *** denote statistical significance at 1%, 5% and 10% levels;*
Automatic maximum lag and lag length selections based on Schwarz Information Criteria

For the full panel, holding everything else constant, a negative relationship between CA and TOT is found while for RER, GDPPC and NX the relationship with CA is reversed. All the estimated coefficients are statistically significant at 1% and 5% levels of significance. Similarly, in context of the SAARC sub panel, the negative relationship between CA and TOT is found to exist, and also the estimated coefficient is statistically significant at 1% level of significance, ceteris paribus. The estimated coefficients of RER and GDPPC are statistically insignificant in this subpanel while a positive relationship is found between CA and NX, which is also statistically significant at 1% significance level. Although the coefficient of TOT is estimated to be negative in the context of the ASEAN subpanel, it is statistically insignificant which the same case is for GDPPC. However, statistically significant negative and positive coefficients of RER and NX, respectively, are also found. Therefore, it can be inferred that the HLM effect following a shock in the TOT value does not hold for any of the three cases. However, a positive relationship between CA and NX is commonly found in all the cases which is in line with the *a priori expectations*.

The panel fixed effects estimated coefficients in context for model (ii) are given in table 6. The results from this model actually shed light on whether the relationship between CA and TOT is linear or otherwise. According to the findings, it can be seen that across all the three panels the coefficient of TOT is positive and highly significant, provided all other factors remaining unchanged. In contrast, the coefficients of the squared terms of TOT, for all three panels, are negative and statistically significant too, ceteris paribus. Thus, a non-linear relationship between CA and TOT can be identified which is held true in all the three cases. This is an important finding since in most cases the existing literature is confined in simply commenting on the CA-TOT relationship without exploring the linearity of the relationship. It can also be inferred that although the HLM effect does not take place initially, the effect does take place later on as perceived from the positive coefficients of the squared TOT variable. In addition, it can also be witnessed that only in case of the ASEAN panel a statistically significant negative relationship is found between GDPPC and CA, assuming everything to be unchanged. Furthermore, the coefficients of NX, in line with that found in the context of model (i), are positive and highly significant at 1% level of significance, ceteris paribus. The inclusion of the squared term for TOT in this model slightly improves the goodness of fit implying a better fit compared to that in model (i).

Table 6: Panel Fixed Effects estimation of model (ii)

	Dependent Variable: CA					
	Full Panel		SAARC Panel		ASEAN Panel	
Variables	**Coefficient**	**Probability**	**Coefficient**	**Probability**	**Coefficient**	**Probability**
TOT	-2.98E+08*	0.000	-6.71E+08*	0.008	-3.55E+08*	0.000
TOT^2	922053.6*	0.000	34774406**	0.021	1216963*	0.000
RER	329928.0	0.145	-32056063	0.525	364454.5	0.133
GDPPC	-17915.47	0.807	1105519	0.353	-263425.5*	0.008
NX	0.726937*	0.000	0.702427*	0.000	0.881489*	0.000
	R^2= 0.949		R^2 = 0.967		R^2 = 0.936	
	Adjusted R^2 = 0.945		Adjusted R^2 = 0.963		Adjusted R^2 = 0.930	

*Notes: * , ** and *** denote statistical significance at 1%, 5% and 10% levels;*
Automatic maximum lag and lag length selections based on Schwarz Information Criteria

The effect of the AFC is incorporated in model (iii) to check the robustness of the non-linearity of the TOT-CA nexus. Results from the fixed effects estimations in context of model (iii) is given in table 7.

Table 7: Panel Fixed Effects estimation of model (iii)

	Dependent Variable: CA					
	Full Panel		SAARC Panel		ASEAN Panel	
Variables	**Coefficient**	**Probability**	**Coefficient**	**Probability**	**Coefficient**	**Probability**
TOT	-2.73E+08*	0.000	-6.78E+08*	0.008	-3.36E+08*	0.000
TOT^2	809985.7*	0.001	3538070*	0.020	1116829*	0.001
TOTDUM	1280340**	0.051	7733194	0.5022	11172035	0.156
RER	354316.8	0.116	-23476643	0.653	378763.3	0.117
GDPPC	1643.849	0.982	1352819	0.280	-231792.4**	0.023
NX	0.723989*	0.000	0.703414*	0.000	0.868877*	0.000
	R^2 = 0.950		R^2 = 0.967		R^2 = 0.937	
	Adjusted R^2 = 0.946		Adjusted R^2 = 0.962		Adjusted R^2 = 0.931	

*Notes: * , ** and *** denote statistical significance at 1%, 5% and 10% levels;*
Automatic maximum lag and lag length selections based on Schwarz Information Criteria

The statistical estimates, as reported, in table 7, suggest that only in the case of the full panel, the coefficient of the TOTDUM variable is positive and statistically significant at 5% significance level, ceteris paribus. Moreover, due to the inclusion of the dummy variable to capture the AFC effects does not impact the non-linear relationship between TOT and CA. The effect of the AFC, coupled with a shock in TOT, however, is statistically insignificant in explaining the variation CA in context of the sub-panels incorporating SAARC and ASEAN countries, respectively.

Model (iv) is used to check whether a shock in TOT can directly influence changes in the home country's NX leading to the problem of DD. The fixed effects estimation results in the context of model (iv) are given in table 8. According to the findings, the estimated coefficients of TOT and TOTDUM are statistically insignificant in explaining the variation in the CA balance across all the three panels, all else being constant. Thus, the possibility of a TOT shock resulting in a direct stimulation of the DD in the home country is minimal in line with the test results. However, only in the context of the SAARC panel, RER is positively related to NX and the estimated slope coefficient of RER is statistically significant at 1% level of significance, ceteris paribus. This finding is in line with economic theory suggesting that an appreciation in the RER would lead to a loss of export competitiveness and increase the demand for imports, eventually attributing to deterioration of the CA balance, vice-versa.

Table 8: Panel Fixed Effects estimation of model (iv)

	Dependent Variable: NX					
	Full Panel		SAARC Panel		ASEAN Panel	
Variables	**Coefficient**	**Probability**	**Coefficient**	**Probability**	**Coefficient**	**Probability**
TOT	62673218	0.252	25452281	0.892	3678268	0.940
TOTDUM	2720106	0.904	-4883089	0.938	14178972	0.471
RER	-52304.73	0.934	4.09E+08*	0.005	-246081.2	0.688
	$R^2 = 0.6187$		$R^2 = 0.608$		$R^2 = 0.729$	
	Adjusted $R^2 = 0.656$		Adjusted $R^2 = 0.572$		Adjusted $R^2 = 0.708$	

*Notes: * , ** and *** denote statistical significance at 1%, 5% and 10% levels;*
Automatic maximum lag and lag length selections based on Schwarz Information Criteria

The panel cointegration tests followed the fixed effects panel estimation tests. The findings from the Pedroni residual-based panel cointegration tests are provided in tables 9, 10, 11 and 12. According to the findings in tables 9 and 10, no evidence of cointegration between the variables is found for the SAARC panel, unlike the cases of the full and the ASEAN panels. On the other hand, with regard to model (iv), as seen from table 12, no cointegration between the variables is found in all three panels. Thus, the corresponding models are later on tested for cointegration using the Johansen-Fisher panel cointegration test.

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Table 9: Pedroni residual-based panel cointegration test for model (i)

Test	Full Panel		SAARC Panel		ASEAN Panel	
	Statistic	**Weighted Statistic**	**Statistic**	**Weighted Statistic**	**Statistic**	**Weighted Statistic**
Within Dimension						
Panel v-statistic	1.283***	-0.678	0.209	0.612	0.712	-2.233
	(0.100)	(0.752)	(0.417)	(0.270)	(0.238)	(0.987)
Panel ρ-statistic	2.418	1.994	2.129	1.047	3.197	3.122
	(0.992)	(0.974)	(0.983)	(0.853)	(0.999)	(0.999)
Panel PP-statistic	-3.737*	-5.100*	1.090	-2.434*	-7.936*	-6.967*
	(0.000)	(0.000)	(0.862)	(0.008)	(0.000)	(0.000)
Panel ADF-statistic	-4.087*	-4.472*	0.932	-3.174*	-6.201*	-4.490*
	(0.000)	(0.000)	(0.842)	(0.001)	(0.000)	(0.000)
Between Dimension						
Group ρ-statistic		3.001		1.973		3.854
		(0.999)		(0.976)		(1.000)
Group PP-statistic		-8.569*		-2.201**		-9.662*
		(0.000)		(0.014)		(0.000)
Group ADF-statistic		-4.817*		-2.640*		-5.482*
		(0.000)		(0.004)		(0.000)

*Notes: Trend assumption: No deterministic trend. Automatic lag length selection based on SIC. Probability values are provided in parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

Table 10: Pedroni residual-based panel cointegration test for model (ii)

Test	Full Panel		SAARC Panel		ASEAN Panel	
	Statistic	Weighted Statistic	Statistic	Weighted Statistic	Statistic	Weighted Statistic
Within Dimension						
Panel v-statistic	0.451 (0.326)	-1.108 (0.866)	0.063 (0.475)	0.231 (0.409)	0.092 (0.463)	-2.393 (0.992)
Panel ρ-statistic	3.304 (1.000)	2.956 (0.998)	2.146 (0.984)	1.449 (0.926)	3.616 (1.000)	3.709 (1.000)
Panel PP-statistic	-5.751* (0.000)	-4.090* (0.000)	0.274 (0.608)	-2.475* (0.007)	-6.362* (0.000)	-5.068* (0.000)
Panel ADF-statistic	-3.362* (0.000)	-3.545* (0.000)	0.161 (0.564)	-2.824* (0.002)	-3.027* (0.001)	-3.004* (0.001)
Between Dimension						
Group ρ-statistic		4.081 (1.000)		2.399 (0.992)		4.485 (1.000)
Group PP-statistic		-8.625* (0.000)		-3.540* (0.000)		-8.156* (0.000)
Group ADF-statistic		-4.475* (0.000)		-2.582* (0.005)		-3.225* (0.001)

*Notes: Trend assumption: No deterministic trend. Automatic lag length selection based on SIC. Probability values are provided in parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

Table 11: Pedroni residual-based panel cointegration test for model (iii)

Test	Full Panel		SAARC Panel		ASEAN Panel	
	Statistic	Weighted Statistic	Statistic	Weighted Statistic	Statistic	Weighted Statistic
Within Dimension						
Panel v-statistic	-0.089 (0.535)	-1.737 (0.959)	3.377* (0.000)	0.952 (0.170)	-0.819 (0.794)	-1.056 (0.855)
Panel ρ-statistic	3.728 (1.000)	3.268 (1.000)	1.402 (0.920)	0.983 (0.837)	3.771 (1.000)	3.171 (0.999)
Panel PP-statistic	-11.568* (0.000)	-8.128* (0.000)	-5.571* (0.000)	-5.299* (0.000)	-8.067* (0.000)	-3.946* (0.000)
Panel ADF-statistic	-5.945* (0.000)	-5.484* (0.000)	-4.394* (0.000)	-4.831* (0.000)	-3.331* (0.000)	-2.915* (0.002)
Between Dimension						
Group ρ-statistic		4.359 (1.000)		1.826 (0.966)		3.962 (1.000)
Group PP-statistic		-15.426* (0.000)		-5.541* (0.000)		-10.513* (0.000)
Group ADF-statistic		-6.949* (0.000)		-4.813* (0.000)		-4.655* (0.000)

*Notes: Trend assumption: No deterministic trend. Automatic lag length selection based on SIC. Probability values are provided in parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

Table 12: Pedroni residual-based panel cointegration test for model (iv)

Test	Full Panel		SAARC Panel		ASEAN Panel	
	Statistic	Weighted Statistic	Statistic	Weighted Statistic	Statistic	Weighted Statistic
Within Dimension						
Panel v-statistic	0.638 (0.262)	0.370 (0.356)	-0.707 (0.763)	-0.852 (0.803)	-0.235 (0.593)	0.372 (0.355)
Panel ρ-statistic	1.281 (0.900)	1.286 (0.901)	2.107 (0.983)	2.026 (0.979)	2.668 (0.996)	2.140 (0.984)
Panel PP-statistic	-0.836 (0.202)	-0.375 (0.350)	-1.435** (0.076)	-0.706 (0.240)	-0.577 (0.282)	-0.750 (0.227)
Panel ADF-statistic	-1.922* (0.027)	-2.154** (0.016)	-1.322*** (0.093)	-2.291** (0.011)	-2.558* (0.005)	-3.599* (0.005)
Between Dimension						
Group ρ-statistic		3.000*** (0.100)		2.764 (0.997)		3.108 (0.999)
Group PP-statistic		0.189 (0.575)		-0.787 (0.216)		-2.231** (0.013)
Group ADF-statistic		-1.032 (0.151)		-1.275*** (0.100)		-3.050* (0.001)

*Notes: Trend assumption: No deterministic trend. Automatic lag length selection based on SIC. Probability values are provided in parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

The second test of cointegration used in this paper is the Johansen-Fisher panel cointegration test. Results from the tests are given in tables 13, 14, 15 and 16 for all the four models, respectively. The results reveal that all the variables considered are cointegrated, thus, allowing to proceed towards the causality tests.

Table 13: Johansen-Fisher Panel Cointegration test for model (i)

Hypothesized No. of Cointegrating Equations(s)	Full Panel		SAARC Panel		ASEAN Panel	
	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)
None	121.6* (0.000)	121.6* (0.000)	41.00 (0.000)*	41.00 (0.000)*	80.61 (0.000)*	80.61 (0.000)*
At most1	471.9* (0.000)	238.3* (0.000)	123.50 (0.000*)	79.43 (0.000)*	348.4 (0.000)*	278.9 (0.000)*
At most 2	209.0* (0.000)	161.4* (0.000)	61.46 (0.000)*	31.16 (0.001)*	147.6 (0.000)*	130.3 (0.000)*
At most 3	84.18* (0.000)	68.30* (0.000)	42.16 (0.000)*	29.70 (0.001)*	42.02 (0.001)*	38.59 (0.003)*
At most 4	62.74* (0.000)	62.47* (0.000)	33.88 (0.000)*	33.88 (0.000)*	28.59 (0.054)***	28.59 (0.054)**

*Notes: Trend assumption: Intercept (no trend) in CE and VAR. Lags interval (in first differences): 1 1. The probabilities are provided in the parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

Table 14: Johansen-Fisher Panel Cointegration test for model (ii)

Hypothesized No. of Cointegrating Equations(s)	Full Panel		SAARC Panel		ASEAN Panel	
	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)
None	19.41 (0.885)	19.41 (0.885)	6.931 (0.732)	6.931 (0.732)	12.48 (0.822)	12.48 (0.822)
At most1	13.86 (0.988)	87.55 (0.000)*	4.159 (0.940)	41.00 (0.000)*	9.704 (0.9411)	46.55 (0.000)*
At most 2	189.8 (0.000)*	189.8 (0.000)*	75.07 (0.000)*	75.07 (0.000)*	114.7 (0.000)*	114.7 (0.000)*
At most 3	257.9 (0.000)*	257.9 (0.000)*	92.10 (0.000)*	92.10 (0.000)*	165.8 (0.000*)	165.8 (0.000)*
At most 4	219.3 (0.000)*	193.5 (0.000)*	62.64 (0.000)*	56.28 (0.000)*	156.7 (0.000)*	137.2 (0.000)*
At most 5	85.37 (0.000)*	85.37 (0.000)*	25.59 (0.004)**	25.59 (0.004)*	59.79 (0.000)*	59.79 (0.000)*

*Notes: Trend assumption: Intercept (no trend) in CE and VAR. Lags interval (in first differences): 1 1. The probabilities are provided in the parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

Table 15: Johansen-Fisher Panel Cointegration test for model (iii)

Hypothesized No. of Cointegrating Equations(s)	Full Panel		SAARC Panel		ASEAN Panel	
	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)
None	19.41 (0.885)	19.41 (0.885)	6.931 (0.732)	6.931 (0.732)	12.48 (0.822)	12.48 (0.822)
At most1	11.09 (0.998)	121.6* (0.000)	6.931 (0.732)	6.931 (0.732)	9.704 (0.9411)	46.55 (0.000)*
At most 2	257.9* (0.000)	257.9* (0.000)	92.10 (0.000)*	92.10 (0.000)*	114.7 (0.000)*	114.7 (0.000)*
At most 3	257.9* (0.000)	257.9* (0.000)	92.10 (0.000)*	92.10 (0.000)*	165.8 (0.000*)	165.8 (0.000)*
At most 4	200.4* (0.000)	165.7* (0.000)	39.92 (0.000)*	25.40 (0.005)*	145.6 (0.000)*	127.7 (0.000)*
At most 5	120.5* (0.000)	120.5* (0.000)	36.13 (0.000)*	36.13 (0.000)*	58.60 (0.000)*	58.60 (0.000)*

*Notes: Trend assumption: Intercept (no trend) in CE and VAR. Lags interval (in first differences): 1 1. The probabilities are provided in the parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

Table 16: Johansen-Fisher Panel Cointegration test for model (iv)

Hypothesized No. of Cointegrating Equations(s)	Full Panel		SAARC Panel		ASEAN Panel	
	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)	Fisher Stat. (trace test)	Fisher Stat. (max-Eigen test)
None	294.5 (0.000)*	235.3 (0.000)*	88.37 (0.000)*	69.39 (0.000)*	206.1 (0.000)*	165.9 (0.000)*
At most1	108.4 (0.000)*	61.53 (0.000)*	33.09 (0.000)*	15.80 (0.105)	75.35 (0.000)*	45.72 (0.000)*
At most 2	73.43 (0.000)*	46.82 (0.013)**	26.79 (0.003)*	15.11 (0.128)	46.64 (0.000)*	31.71 (0.023)**
At most 3	81.44 (0.000)*	81.44 (0.000)	33.51 (0.000)*	33.51 (0.000)*	47.93 (0.000)*	47.93 (0.000)*

*Notes: Trend assumption: Intercept (no trend) in CE and VAR. Lags interval (in first differences): 1 1. The probabilities are provided in the parenthesis. * , ** and ** denote statistical significance at 1%, 5% and 10%, respectively.*

The short-run causal analysis is done only in the context of model one in order to specifically understand the causal association between TOT and CA balance. The VECM approach was employed and the corresponding results are provided in tables 17, 18 and 19. The VECM results in the context of the full panel, as reported in table 17, there is no short-run causality between TOT and CA. However, a unidirectional causality is found to be running from RER to CA implying that in the short run a change in the home country's RER is effective in influencing movements in its CA balance. In contrast, no causal associations between CA and GDPPC and between CA and NX can be seen in the light of the results found. In addition, holding CA to be the dependent variable, the Error Correction Term (ECT) has a value of -0.610 and is found to be highly significant. This implies that in any disequilibrium in the previous lag gets corrected by almost 61% in the next lag.

Table 17: VECM results for the Full Panel

	Sources of Causation					
Dependent Variable	**Short run**					**Long Run**
	CA	**TOT**	**RER**	**GDPPC**	**NX**	**ECT**
CA	-	0.418 (0.559)	2.469*** (0.088)	1.344 (0.264)	0.843 (0.432)	-0.610* (0.000)
TOT	0.195 (0.823)	-	0.164 (0.849)	4.233 (0.016)**	0.151 (0.860)	-0.004 (0.736)
RER	0.331 (0.718)	0.383 (0.682)	-	0.241 (0.786)	0.204 (0.815)	-0.039* (0.001)
GDPPC	0.611 (0.544)	11.170 (0.000)	0.012 (0.989)	-	0.294 (0.746)	-0.002 (0.720)
NX	1.971 (0.142)	0.211 (0.810)	1.895 (0.153)	0.531 (0.589)	-	0.331* (0.000)

*Notes: The Chi-squares statistics for the explanatory variables are reported while the corresponding probabilities are given in the parentheses. The short-run causality is determined by the statistical significance of the Chi-squares statistics. *, ** and ** denote the statistical significance of the Chi-squares statistics at 1%, 5% and 10% levels of significance.*

The VECM results reported in table 18 suggest that in context of the panel of SAARC nations, TOT is ineffective in causing changes in CA balance as no short-run causality between the two variables can be estimated. However, a unidirectional causality running from GDPPC to CA and bidirectional causality between CA and NX can be identified. This means that for the SAARC countries, CA balance is determined by the changes in the level of economic growth in respective nations. In addition, CA and NX are interdependent variables as both have the power to cause changes in one another. The findings are in line with conventional theories of economics relating the concerned variable.

Table 18: VECM results for the SAARC Panel

Dependent Variable	Sources of Causation					
	Short run					Long Run
	CA	TOT	RER	GDPPC	NX	ECT
CA	-	0.066	0.066	3.418**	4.321*	-1.963*
		(0.936)	(0.936)	(0.040)	(0.018)	(0.000)
TOT	1.820	-	0.165	0.589	1.557	-0.031
	(0.172)		(0.848)	(0.558)	(0.220)	(0.153)
RER	0.709	0.217	-	2.426***	0.601	-0.006
	(0.498)	(0.806)		(0.100)	(0.553)	(0.171)
GDPPC	0.634	1.958	1.540	-	0.828	-0.0054
	(0.535)	(0.1511)	(0.224)		(0.443)	(0.255)
NX	7.972*	0.061	0.103	3.625**	-	1.173*
	(0.001)	(0.941)	(0.902)	(0.033)		(0.000)

*Notes: The Chi-squares statistics for the explanatory variables are reported while the corresponding probabilities are given in the parentheses. The short-run causality is determined by the statistical significance of the Chi-squares statistics. *, ** and ** denote the statistical significance of the Chi-squares statistics at 1%, 5% and 10% levels of significance.*

In table 19, the VECM results in the context of the panel incorporating the ASEAN countries assert that TOT, as in the cases with the full and the SAARC panel, has no causal relationship with CA in the short run. In addition, the results also suggest a unidirectional causality running from RER to CA, much like the case in the context of the full panel. The statistically significant ECT having a value of -0.296 portrays that disequilibrium in the previous lag gets corrected by almost 29.6% in following lag implying a moderate rate of correction.

Table 19: VECM results for the ASEAN Panel

Dependent Variable	Sources of Causation					
	Short run					Long Run
	CA	TOT	RER	GDPPC	NX	ECT
CA	-	0.877	2.604**	1.933	2.009	-0.296**
		(0.419)	(0.079)	(0.150)	(0.139)	(0.019)
TOT	0.019	-	0.148	4.292**	0.011	-0.002
	(0.981)		(0.863)	(0.017)	(0.989)	(0.889)
RER	0.166	0.263	-	0.233	0.172	-0.051
	(0.847)	(0.769)		(0.793)	(0.8422)	(0.003)*
GDPPC	0.616	9.815*	0.027	-	0.296	-0.002
	(0.542)	(0.000)	(0.974)		(0.744)	(0.872)
NX	0.877	-1.883**	1.934	2.009	-	-0.296**
	(0.419)	(0.062)	(0.150)	(0.139)		(0.0189)

*Notes: The Chi-squares statistics for the explanatory variables are reported while the corresponding probabilities are given in the parentheses. The short-run causality is determined by the statistical significance of the Chi-squares statistics. *, ** and ** denote the statistical significance of the Chi-squares statistics at 1%, 5% and 10% levels of significance.*

In order to check the robustness of the short run causal associations found in the VECM analysis, the panel Granger causality tests are used to detect the long run causalities as well. The Granger causality tests were done in the context of model (i) for each of the three panels. The findings are reported in tables 20, 21 and 22. As far as the full panel is concerned, the Granger causality test results reported in table 20 reveal that there are no long-run causal associations between CA and the two explanatory variables TOT and RER. However, results also confirm a unidirectional causality running from GDPPC to CA and a bidirectional causality between CA and NX.

Table 20: The Granger causality test results for the full panel (Lag=2)

Null Hypothesis	F-Statistic	Probability
TOT does not Granger cause CA	0.426	0.653
CA does not Granger cause TOT	0.116	0.891
RER does not Granger cause CA	0.256	0,775
CA does not Granger cause RER	0.805	0.449
GDPPC does not Granger cause CA	2.654**	0.073
CA does not Granger cause GDPPC	0.941	0.392
NX does not Granger cause CA	4.277**	0.015
CA does not Granger cause NX	6.424*	0.002

*Notes: *, ** and *** denote the statistical significance of the estimated F-statistics at 1%, 5% and 10% levels of significance. The optimal lag is automatically selected by the EViews 7.1 software.*

In the context of the panel of SAARC nations, the Granger causality test outcomes are reported in table 21. According to the findings, CA balance has no causal association with TOT, RER and GDPPC. In contrast, a bidirectional causality is found to be existing between CA and NX in the long run.

Table 21: The Granger causality test results for the SAARC panel (Lag=2)

Null Hypothesis	F-Statistic	Probability
TOT does not Granger cause CA	0.824	0.443
CA does not Granger cause TOT	1.496	0.231
RER does not Granger cause CA	1.560	0.217
CA does not Granger cause RER	0.278	0.759
GDPPC does not Granger cause CA	1.839	0.167
CA does not Granger cause GDPPC	0.618	0.542
NX does not Granger cause CA	8.761*	0.000
CA does not Granger cause NX	11.463*	0.000

*Notes: *, ** and *** denote the statistical significance of the estimated F-statistics at 1%, 5% and 10% levels of significance. The optimal lag is automatically selected by the EViews 7.1 software.*

The Granger causality test results in the context of the ASEAN panel are given in table 22. According to the results, there is no long-run causality between CA balance and none of the explanatory variables as none of the estimated F-statistics are statistically significant.

Table 22: The Granger causality test results for the ASEAN panel (Lag=2)

Null Hypothesis	F-Statistic	Probability
TOT does not Granger cause CA	0.688	0.504
CA does not Granger cause TOT	0.199	0.820
RER does not Granger cause CA	0.759	0.470
CA does not Granger cause RER	1.270	0.284
GDPPC does not Granger cause CA	1.742	0.179
CA does not Granger cause GDPPC	0.901	0.409
NX does not Granger cause CA	1.080	0.342
CA does not Granger cause NX	2.146	0.121

*Notes: *, ** and *** denote the statistical significance of the estimated F-statistics at 1%, 5% and 10% levels of significance. The optimal lag is automatically selected by the EViews 7.1 software.*

7. Conclusions

Maintaining a favorable TOT index is always desirable from any open economy's perspective, irrespective of it being developed or underdeveloped. Conversely, a shock in the TOT can lead to macroeconomic distortion with the economy, disrupting the development strategies already in place. The HLM effect explains how a negative shock in the TOT can reduce national savings in the home economy and thereby worsen the CA balance. Thus, the TOT-CA nexus is a crucial area of research from the perspective of open economies that are gradually liberalizing trade to embrace globalization. The aim of this paper is to shed light on the TOT-CA association in light of the HLM effect, incorporating data from 14 selected countries within the SAARC and ASEAN regions. In addition, the paper also looks to relate a TOT shock to the DD problem in the aforementioned panel of Asian countries. Furthermore, this paper also investigates the direction of short run and long run causalities between CA balance and its macro determinants.

According to the findings of this paper, the relationship between a temporary change in TOT and CA balance is negative with regard to the full panel and the SAARC panel. However, the negative relationship is not statistically significant in the context of the ASEAN panel. Thus, the results, corroborating to the conclusions made by Rakshit *et al.* (2015), are in contradiction to the HLM effect hypothesis that refers to a positive correlation between the two variables. However, the findings also reveal that although the TOT-CA association is initially negative, it becomes positive at some point revealing a non-linear relationship between a persistent TOT shock and the response in CA balance. The non-linearity of this relationship is found to hold across all the three panels considered in the paper. Hence, this paper finds evidence of both the Obstfeld-Svensson-Razin and the HLM effects in context majority of the South and Southeast Asian countries as a whole. Furthermore, the AFC is found to affect the TOT-CA balance nexus positively only in the context of the full panel while in the other two cases the corresponding estimated coefficient is statistically insignificant. As far as the DD problem is concerned, the results reported find TOT shocks ineffective in influencing the NX across all the three panels. Thus, the finding contradicts the views expressed by Nedeljkovic *et al.* (2015) in context of Germany where adverse TOT shocks resulted in declining export volumes in the German economy.

The causality findings in this paper reveal that there is neither short run nor long-run causality between TOT and CA balance across all the three panels. However, in the short run, a unidirectional causality running from RER to CA in context of the full and the ASEAN panels is found. In addition, a unidirectional causality from GDPPC to CA and a bidirectional causality between NX and CA in context of the SAARC panel can also be seen. The bidirectional causality between NX and CA is also found to hold in the long run as well, but only in the context of the full and the SAARC panels. The causality estimations provide robustness to the elasticity estimates derived from the fixed effects model estimation techniques employed in the paper.

Data inadequacy was the main limitation restricting the further robustness of the findings in this paper. Due to the data constraint, some crucial explanatory and controlled variables could not be incorporated into the models. Moreover, the study is somewhat confined due to using annual data rather than disaggregating annual data into quarterly or monthly data that could have added to the richness of the overall findings. As part of the future scope of research, country-specific HLM effect investigations can be undertaken along with detailed analysis of the possible TOT shock induced DD problem in the home countries.

References

Aquino, JC and Espino, YF 2013, 'Terms of Trade and Current Account Fluctuations: a Vector Autoregression Approach', *Central Reserve Bank of Peru Working Paper Series No. 008.*

Balassa, B 1964, 'The Purchasing Power Parity Doctrine: A Reappraisal', *Journal of Political Economy*, Vol. 72, pp. 584-596.

Bank of Thailand 2013. *Thailand's Economic Conditions in 2013.*

Barder, O 2006, 'A Policymaker's Guide to Dutch Disease: What is Dutch Disease and is it a Problem', *Center for Global Development Working Paper No. 91.*

Bitzis, G, Paleologos, JM and Papazoglou, C 2008, 'The Determinants of the Greek Current Account Deficit: The EMU Experience', *Journal of International and Global Economic Studies*, Vol. 1, No. 1, pp. 105-122.

Bouakez, H and Kano, T 2008, 'Terms of Trade and current account fluctuations: The Harberger-Laursen-Metzler effect revisited', *Journal of Macroeconomics*, Vol. 30, pp. 260-281.

Breitung, J 2000, 'The local power of some unit root tests for panel data.' In: B. H. Baltagi, ed., *Nonstationary Panels, Panel Cointegration, and Dynamic Panels.* Elsevier, Amsterdam, pp. 161-177.

Carlin, W and Soskice, D 2006, 'Macroeconomics: Imperfections, Institutions and Policies. Oxford University Press.

Corden, MW and Neary, PJ 1982, 'Booming Sector and Deindustrialization in a Small Open Economy', *Economic Journal*, Vol. 92, pp. 825-848.

Coudert, V, Couharde, C and Mignon, V 2008, 'Do Terms of Trade drive Real Exchange Rates? Comparing Oil and Commodity Currencies', *Working Paper CEPII No. 32.*

Desormeaux, J and Garcia. P 2009, 'Terms of Trade, Commodity Prices and Inflation Dynamics in Chile', Central Bank of Chile Economic Policy Papers No. 32.

Engle, RF and Granger, CWJ 1987, 'Co-integration and Error-correction: Representation, Estimation and Testing', *Econometrica, Vol.* 55, No. 2, pp. 251-276.

Granger, CWJ 1969, 'Investigating Causal Relations by Econometric Models and Cross-Spectral Models', *Econometrica*, Vol. 37, pp. 424-438.

Granger, CWJ 1980, 'Testing for Causality: A Personal Viewpoint', *Journal of Economics, Dynamics and Control*, Vol. 2, pp. 329-352.

Granger, CWJ 1988, 'Some recent development in a concept of causality', *Journal of Econometrics*, Vol. 39, No. 1-2, pp. 199-211.

Hadri, K 2000, 'Testing for stationarity in heterogeneous panel data', *Econometrics Journal*, Vol. 3, pp. 148-161.

Harberger, AC 1950, 'Currency Depreciation, Income and the Balance of Trade', *Journal of Political Economy*, Vol. 58, No. 1, pp. 47-60.

Hausman, J 1978, 'Specification Tests in Econometrics', *Econometrica*, Vol. 46, pp. 1251-1271.

Idrees, T and Tufail, S 2012, 'The Harberger-Laursen-Metzler effect: Evidence from Pakistan', *The Lahore Journal of Economics*, Vol. 17, No. 2, pp. 87-110.

Im, KS, Pesaran, MH and Shin, Y 2003, 'Testing for unit roots in heterogeneous panels', *Journal of Econometrics,* Vol. 115, pp. 53-74.

Johansen, S 1988, 'Statistical Analysis of Cointegrated Vectors. *Journal of Economic Dynamics and Control',* Vol. 12, No. 2, Issue 3, pp. 231-254.

Kallon, KM 2012, 'Growth Empirics: Evidence from Sierra Leone', *African Development Review*, Vol. 25, No. 2, pp. 215-230.

Kwiatkowski, D *et al.* 1992, 'Testing the null hypothesis of stationarity against the alternative of a unit root', *Journal of Econometrics*, Vol. 54, pp. 159-178.

Laursen, S and Metzler, L 1950, 'Flexible Exchange Rates and the theory of Employment', *Review of Economics and Statistics*. Vol. 32, No. 4, pp. 281-299.

Levin, A, Lin, CF and Chu, C-SJ 2002, 'Unit root tests in panel data: Asymptotic and finite sample properties', *Journal of Econometrics*, Vol. 108, pp. 1-22.

Lukáčik, M, Szomolanyi, K and Lukáčiková, A 2016, 'Terms-of-Trade Shocks and Slovak Economy', *Acta Universitatis Bohemiae Meridionalis*, Vol. 19, No. 1, pp. 10-19.

Maddala, GS and Wu, S 1999, 'A comparative study of unit root tests with panel data and a simple new test', *Oxford Bulletin of Economics and Statistics*, Vol. 61, pp. 631-652.

Nedeljkovic, M, Varela, G and Zangrandi, MS 2015, 'Indonesia Current Account Assessment', *World Bank Other Operational Studies 22340.*

Obstfeld, M 1981, 'Macroeconomic Policy, Exchange Rate Dynamics and Optimal Asset Accumulation', *Journal of Political Economy*, Vol. 89, pp. 1142-1161.

Otto, G 2003, 'Terms of Trade Shock and the Balance of Trade: There is a Harberger-Laursen-Metzler effect', *Journal of International Money and Finance*, Vol. 22, No. 2, pp. 155-184.

Pedroni, P 2004, ‘Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis’, *Econometric Theory*, Vol. 20, pp. 597-627.

Rakshit, TK, Chowdhury, TI and Moktadir, MG 2015, ‘Responses to Balance of Trade of Bangladesh through the Changes of Influencing Factors (GDP, TOT, FDI, ER, FR): An Econometric Analysis’, *Asian Journal of Multidisciplinary Studies*, Vol. 3, No. 6, pp. 95-103.

Ramirez, MD 2006, ‘A Panel Unit Root and Panel Cointegration Test of the Complementarity Hypothesis in the Mexican Case, 1960-2001’, *Yale University Economic Growth Center Discussion Paper No. 942.*

Sachs, JD 1981, ‘The Current Account and Macroeconomic Adjustment in the 1970s’, *Brookings Papers on Economic Activity*, Vol. 12, No. 1, pp. 201-282.

Samuelson, PA 1964, ‘Theoretical Notes on Trade Problems’, *Review of Economics and Statistics*, Vol. 46, pp. 145-154.

Svensson, LEO and Razin, A 1983, ‘The Terms of Trade and the Current Account: The Harberger-Laursen-Metzler Effect’, *Journal of Political Economy*, Vol 91, pp. 97-125.

Thorbecke, W and Kato, A 2012, ‘The effect of exchange rate changes on Germany’s exports’, *RIETI Discussion Paper No. 12-E-081.*

Uneze, E 2011, ‘Foreign Aid and the Real Exchange Rate in the West African Economic and Monetary Union (WAEMU)’, *Applied Econometrics and International Development,* Vol. 11, No. 1, pp. 147-169.

World Bank. 2017. World Development Indicators.

Appendix

Fig. 3: Responses of an economy following a negative shock in its TOT index.