Two way Panel Causality Analysis for Degree of Trade Openness and Size of City

Uzma Tabassum[*] and Shaista Alam

Applied Economics Research Centre (AERC), Pakistan

Abstract: The relationship between trade openness and economic size of city has long been a subject of much interest in international literature of trade. Trade Openness might increases the economic size of city by increasing the significance of transportation modes which are mostly present in urban areas and raising the demand for marketing, financing and communication. In contrast some literature argue that protectionism generates large cities as firms cluster in an urban area to minimize its unit cost via sharing of intermediate goods, labour pool and knowledge spill-over. Thus, there exist an important causal connection between the economic size of the city and its contribution in international trade. This paper is designed to explore these causal connections using panel causality analysis. The panel consists of fourteen major cities of Pakistan and 14 years commence from 1999-00 till 2012-13. The result affirms a positive two-way causal relationship between a cities' economic size and its degree of trade openness.

Keywords: Trade Openness, Economic city size, Panel causality, Growth, Region.

1. INTRODUCTION

The relationship between trade openness and economic size of city has long been a subject of much interest in international literature of trade. Most of the literature pays attention towards correlation between trade openness and city size in term of its economic contribution or growth, subject to the other determinants of growth but relatively little attention has been paid towards causal analysis between trade and growth. The theoretical literature about the relationship between openness and growth can be divided into two lines. The first line of literature supports the proposition that openness effect economic size of the region or region's growth of income positively [34, 41]. They argue that in the regions that are more open to trade has a greater ability to catch up to leading technologies of the rest of the world. In these regions significance of transportation modes also increases. Further literature indicates that trade openness prop up the efficient allocation of resources through comparative advantage. It also encourages competition in local and international markets by allowing spreading of knowledge and technological advancements [8]. In contrast some theoretical studies point out that openness reduces cities economic size. With trade openness clustering of firms in an urban area, to minimize its average cost through sharing of raw material, labour pool and knowledge spill-over no longer required. When the economy becomes open to international trade, firm can minimizes its average cost

of production via importing raw materials from more competitive international market rather than the domestic one [17, 29]. These contradictory theoretical findings also appear in empirical literature.

Vast empirical work has been done to identify the relationship between trade openness and economic growth. These works can be alienated into two sets, the first set of studies tried to capture the association between them by using conventional regression analysis. Majority of the studies conclude that trade openness is a significant explanatory variable for growth of the same region [14, 20, 26]. These studies focused only on unidirectional possible relationship among openness and economic growth and unable to cover their bidirectional causal relationship. The second set of empirical work uses Grange Causality analysis to find out their causal relationships [9, 2, 27, 23]. These empirical studies show mixed results. Some studies found bidirectional causality among two in both negative and positive direction but other only confirmed unidirectional causality from export to growth or growth to export.

In the light of these theoretical and empirical findings we would expect important causal connections to exist between the economic size/growth of the regions and its contribution in international trade. The proposition that the more open economies grow faster has gained large acceptance therefore various nations have opened their economies and reduced trade barriers for the purpose of economic growth. Like other developing nations Pakistan also follow trade liberalization policies but either these polices contribute in economic growth or economic growth accelerate the process of trade openness. This paper is designed to

*Address correspondence to this author at the Applied Economics Research Centre (AERC), Pakistan; Tel: (92)21-99261541-43;
E-mail: uzma_tbsm@hotmail.com

explore these causal connections between trade openness and city size measured by cities contribution in Gross Domestic Product (GDP) using panel causality analysis for the panel of fourteen major cities of Pakistan. The paper commenced with the basic understandings about trade openness and economic city size in section-1 establishing a theoretical and empirical base in section-2, specifying theoretical framework adopted backing the research design in section-3, econometric methodology and data sources and construction of variable in section-4 interpreting causality results in section-5, providing conclusions and recommendation in section -6 along with the appendix attached at last followed by references.

2. REVIEW OF LITERATURE

2.1. Theoretical Review of Literature

The theoretical literature about trade openness and city size is based on the question that: How economic size of cities is changed as international trade barriers remove or foreign trade becomes less costly? Thus for a view point of having in depth understanding of this relationship scrutiny of the core available theoretical models "urban system", somewhat older approach based on perfect competitive market [21] and more recent " New Economic Geography" (NEG) approach which permits monopolistically competitive market [30], is to be done.

Henderson has a seminal contribution in explaining the equilibrium model of external trade and internal geography [22]. Henderson develops the model of city size under the assumptions of perfect mobility of workers and goods within a country, constant return to scale in production, and homogenous goods. Model also assumes mono-centric cities, that larger cities spend more on their workers resources and commuting. In contrast to neo-classical trade theories, in this model city level scale economies exists. These scale economies that are external to firm permits perfect competition. In equilibrium, every city specialized in the production of one traded good and as well as one non-traded good "housing". Due to differences in endowments and amenities cities of different sizes and sectoral specializations coexist in equilibrium. As the degree of scale economies and the overall size of the industry in which a city is specialized increases the size of cities also increases. According to this model of Henderson trade protectionism has spatial effects as it raises urban concentration.

Within in a country some regions have the benefit of easier access to foreign market than others. This differential in access to foreign market will matter more when country is large and diversified in term of geography and infrastructure [7]. Rauch formulate a model of cities with heterogeneous regions. The cities those are closer to the port facing lower international trade cost than interior cities so these cities partly specialize and engage in foreign trade. The trading cities which are closer to the port will be monotonically lager. With same internal trade cost if international trade cost is too low the interior cities will also specialize and engage in foreign trade and the size of cities will decline monotonically with distance from the port [39]. In short the Rauch model states that trade openness with unchanged intra-national trade cost allied with increasing urban agglomeration and with a move of population towards cities with better access to foreign market.

Krugman and Elizondo were first to analyse regional adjustment to international trade liberalization in a new economic geography (NEG) model [29, 31]. In contrast to Henderson model in which the size and number of cities were predictand, the NEG model exogenously divides countries into region. Models of economic geography entail a tension between "centripetal forces" that have a propensity to drag population and production into agglomeration and the "centrifugal forces" that have a tendency to break such agglomeration. Krugman & Elizondo includes only the centripetal forces in their model that comes from the interaction between economies of scale, market size and transportation cost. In this model there is only one factor of production labour that is fixed in supply and perfectly mobile between domestic locations [31]. In the presences of strong trade barriers with the rest of the world the firms might be willing to pay high wage rate in order to locate at Central Business Districts (CBDs) just to grab agglomeration benefits. On the other hand the labours counterbalance high commuting cost or land rent that they face due to live in CBDs by better access to the goods and services produced there as can be seen from the Figure **1** below.

But in the absences of protectionist trade policy the sustainable agglomeration of firms become unsustainable because with trade liberalization firm will now sell their output to the world market and also gets their intermediate input from foreign markets so contact to main domestic market turn out to be less crucial and thus the wage rate the firms are agreeable to pay for locating CBDs go down (see Figure **2**).

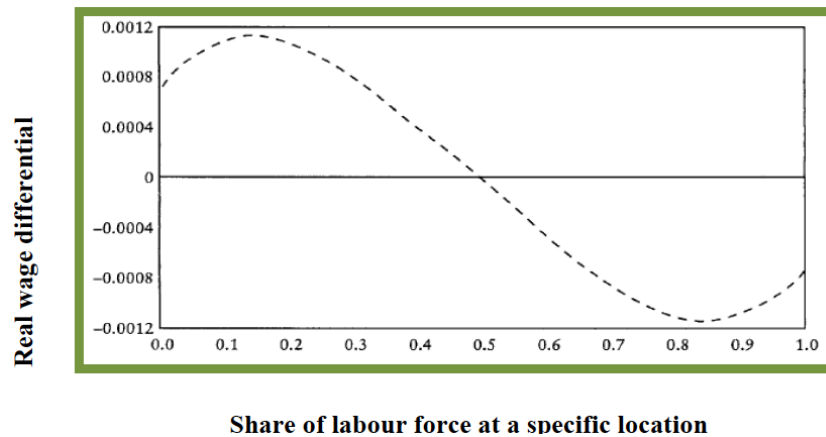**Figure 1:** Agglomeration under protectionist trade policies.

Figure 2: Agglomeration under liberal trade policies.

At the same time, labours also have opportunity to consume more imported goods instead of domestic goods therefore they also will be not willing to bear high commuting and land costs in order to be close to domestic suppliers. Behrens *et al.* also reached at the same conclusion that external trade liberalization supports internal dispersion but the way through which they explain this effect however differ from that of Krugman & Elizondo. Instead of urban congestion cost assumed by krugman and Elizondo their model assume two other diffusion forces one arise from immobile workers (farmers) and the other from competition effect that comes from high concentration of firms. They reached to the conclusion that with unchanged internal transportation cost external trade liberalization reduces pace of agglomeration internally or in other words it favours internal dispersion [5]. So far we have not discussed the heterogeneous feature offered by various place under new economic geography models though that worth to be discussed. Alonso was first to incorporate this heterogeneity explicitly to Krugman and Elizonto model [3]. According to him trade liberalization benefits border region more

in relation to non-border regions by lowering cost to access foreign market. Brulhart further explained that keeping all else equal if foreign demand (supply) is much greater in comparison with the domestic one, trade liberalization will encourage firms concentrations at border regions by dispersing firm agglomerations in non-border region towards border areas so as to reduce the cost to access foreign market. For the other side of the picture when foreign demand (supply) sufficiently short-length domestic demand (supply) firms prefer to agglomerate in non-border region so as to shelter themselves from foreign competition and to cover greater domestic market following central location theory [7].

2.2. Empirical Literature

The concept of trade openness occupies a prominent place in the growth process of a specific region. The relationship between trade openness and growth or economic size of city is not a clear one. Henderson has a decisive contribution in elucidation the equilibrium frame work of trade liberalization and

internal geography. According to Henderson the effect of trade liberalization depend on the geography of particular region [22]. The cities closer to the port benefited more with trade liberalization hence trade openness is allied with enhance urban concentration [39]. In contrast some studies support off-putting relationship between trade openness and urban concentration or growth and wrap up with the argument that external trade liberalization supports internal dispersion [5, 30, 31].

Rosen & Resnick published his empirical work on this issue for 43 countries. They took primacy measure as their dependent variable and export to GDP ratio as independent one. They came to the conclusion that openness has negative impact on primacy measure [42]. Ades and Glaeser used the data from 1970 to 1985 for 85 countries to establish the relationship between trade openness and city size. Trade openness variable is defined as trade to GDP ratio and concentration is measured as population in the largest city. Results indicated a negative relationship between trade openness and city size [1]. Empirical work done by Moomaw and Shatter comprises the data set on urban primacy for the years 1960, 1970 and 1980. Using export to GDP ratio as a measure of trade liberalization their results also established a negative relationship [35]. This point forward the literature presented support Ricardian's ideology.

Using developing countries data from 1990-87 and 1978-88 Harrison found that more trade openness, for most of the alternative measure he used for openness, linked positively with higher growth levels [20]. A significant positive impact was found between openness and growth based on a penal analysis performed by Wacziarg using a penal of 19 years (1970-89) and 57 countries [47]. Longitudinal cross countries time series analysis starting from 1870 to 1990 revealed that positive openness-growth link was a recent phenomenon which was not significantly observed before 1970 [46]. On the basis of 1960-00 data for 22 developed and 60 developing countries, empirical result revealed that trade openness and economic growth were pro-cyclical especially for developing countries this link can be enhance with human capital formation, flexibility in labour market, price stability, financial and governance reforms along with public goods availability [8]. In china trade liberalization and region's growth was found directly proportional to one another as for the data from 1987 to 2005 [48].

Though openness-growth relationships grabbed the attention of various researchers in the existing literature, causal connection between the two was unduly ignored. Degree of trade openness is determined by the level of income hence there might exist a possibility of long run causal connection between the two [36]. The study on China shows bi-causality in export and growth [33]. Gries and Redlin explored the causal relationship between openness and trade over a data set of 158 countries spread over a time span from 1970 to 2009. They found significant positive causality running from openness to growth suggesting that international integration would lead to growth in long run. For short run openness might be painful as indicated by a negative causal coefficient [19]. The same was revealed for Bulgaria [4]. In contrast, the study investigated data for Morocco over the period 1960-00 concluded that in long run the two key variables, trade and economic growth, were not causally related while in short run the causality exits [6].

For OECD countries results of panel causality test specified that openness caused growth in developing countries and that a boost in economic performance is one of the major causes of increased openness. For both developed and developing nations their result was robust and exhibits bidirectional causality running from trade openness (TO) to economic growth (GDP) [25].

3. THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

The relationship between Economic growth & trade openness is inter-related as can be seen in Figure **3**.

Trade Openness is considered as an important tool for economic growth in both developed and developing countries [11]. With regard to a theoretical relationship between openness and growth most of the studies provide support for the proposition that trade openness effects growth positively. Increased openness is believed to have positive impact on productivity, which in turn improves employment and real wages as a result of new investments [28]. The resulting growth process further accelerate investment which in turn raises the demand of imported raw materials and the ability of supplying goods and services to international markets. The effects of trade openness on intra-national economic geographies also has immense important. As per World Development Report "The openness to trade and capital flows that makes markets more global also makes sub national
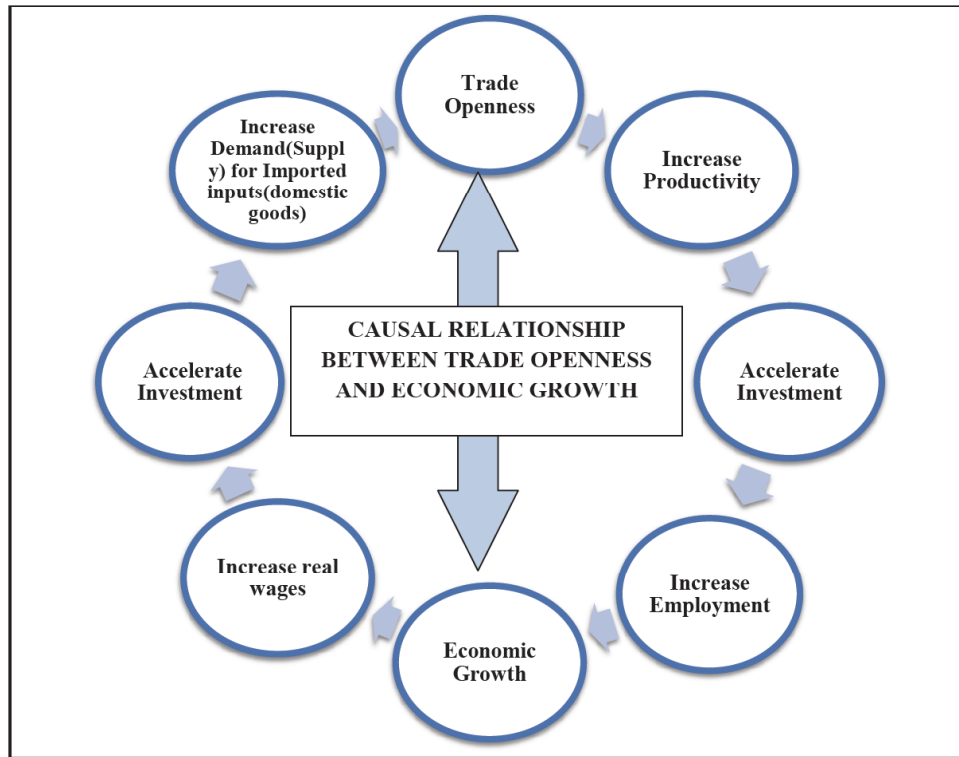
Figure 3: Causal relationship between trade openness and economic city size.

Source: Author illustration.

disparities in income larger and persist for longer in today's developing countries. Not all parts of a country are suited for accessing world markets, and coastal and economically dense places do better."

Trade Openness might increases the economic size of city for two reasons. First it may increase the significance of transportation modes which are mostly present in urban areas. Moreover, the coastal areas are relatively blessed with the ease to access the international markets than other areas making them more responsive to trade openness. Second, it may raise the demand for marketing, financing and communication making an urban location more important [34]. In contrast, protectionism generates large cities as firms cluster in an urban area to minimize its unit cost via sharing of intermediate goods, labour pool and knowledge spill-over. When the economy becomes open to international trade, firm minimizes its unit cost via importing inputs from more competitive world market rather than the domestic one. Hence the need for clustering at a location decreases affecting the size of an urban area [17, 29].

From this theoretical framework we would expect important causal connections to exist between the economic size/growth of the city and its contribution in

international trade. To explore these causal connections this research used the following bidirectional causality model

$$TO_t = f(ECS_{t-k}, TO_{t-k}) \tag{1}$$

$$ECS_t = f(TO_{t-k}, ECS_{t-k}) \tag{2}$$

Where

TO = Trade Openness

ECS = Economic City size

4. ECONOMETRIC METHODOLOGY

In order to estimate direction of causality between trade openness and economic size we use panel causality analysis. Considering methodology of Hurlin and Venet [24], extension of the Granger causality test for panel data [18], for each individual j the empirical model is as follows:

$$Y_{jt} = \sum_{k=1}^{p} \gamma^{(k)} Y_{j,t-k} + \sum_{k=0}^{p} \beta^{(k)} X_{j,t-k} + \mu_{j,t}; \; |\gamma| < 1 \tag{3}$$

With $p \in N^*$ and $\mu_{j,t} = \alpha_j + \varepsilon_{j,t}$ where $\varepsilon_{j,t}$ are i.i.d $(O, \sigma^2 \varepsilon)$. Hurlin and Venet assumes that the autoregressive coefficients $\gamma^{(k)}$ and the regression's

slopes coefficients $\beta_j^{(K)}$ are constant $\forall k, \in [1, P]$. Also assume that parameters $\gamma^{(k)}$ are the same for all individuals, whereas the regression slopes coefficients $\beta_j^{(K)}$ may have an individual dimension. They consider four principal cases:

Homogenous Non-Causality Hypothesis (HNCH)

The 1st case deals with homogenous non-causality Hypothesis (HNCH). The hypotheses assume that individual causality association is present:

$$\forall_j \in [1,N]\, E\left(y_{j,t} / \overline{y}_{jt}, \alpha_j\right) = E\left(y_{j,t} / \overline{y}_{j,t}, \overline{x}_{j,t}, \alpha_j\right) \qquad (4)$$

In Eq-1 the same case is defined as:

$$H_o : \beta_j^{(K)} = 0 \;\; \forall_j \in [1,N], \forall K \in (1,p)$$
$$H_a : \exists (j,K) / \beta_j^{(K)} \neq 0 \qquad (5)$$

Next to test these Np linear restrictions, following Wald Statistic is computed:.

$$F_{HNCH} = \frac{(RSS_2 - RSS_1)/(Np)}{RSS_1 / [NT - N(1+p) - p]} \qquad (6)$$

where,

RSS$_2$ stands for the restricted sum of squared residual acquired under Ho and RSS$_1$ denotes the residual sum of squares of Model (1).

If the F_{HNCH} statistic is not significant, the homogeneous non-causality hypothesis is accepted. This result implies that the variable **X** is not causing **Y** in the entire cross sectional units. The non-causality result is totally homogenous that stops further empirical investigation.

Homogenous Causality Hypothesis (HCH)

The next case corresponds to the homogenous causality (HC) hypothesis, wherein there exist N causality relationships:

$$\forall_j \in [1,N]\;\; E\left(y_{j,t} / \overline{y}_{j,t}, \alpha_j\right) = E\left(y_{j,t} / \overline{y}_{j,t}, \overline{x}_{j,t}, \alpha_j\right) \qquad (7)$$

In this case, we suppose that the N individual predictors, acquired conditionally to $\overline{y}_{j,t}, \overline{x}_{j,t}$ and α_j, are the same:

$$\forall_{(j,i)} \in [1,N]\;\; E\left(y_{j,t} / \overline{y}_{jt}, \overline{x}_{j,t}, \alpha_j\right) = E\left(y_{j,t} / \overline{y}_{i,t}, \overline{x}_{i,t}, \alpha_i\right) \qquad (8)$$

In case of accepting alternate hypothesis of HNCH two configurations appear. The first configuration corresponds to overall Homogenous Causality Hypothesis (HCH) in which there exists N causality relationship. In this case, we assume that all the coefficients $\beta_j^{(K)}$ are identical for all k. Another more plausible configuration is that some coefficients $\beta_j^{(K)}$ are different for each individual. So after accepting alternate hypothesis of HNCH further procedure consists in testing whether the slope coefficients of regression associated to $x_{j,t\,k}$ are identical. This test is corresponds to a standard homogeneity test. Formally, the Homogenous Causality Hypothesis (HCH) test is the following:

$$H_o : \forall k \in [1,p]\;\; / \beta_j^k = \beta^k \;\forall_j \in [1,N] \qquad (9)$$

$$H_a : \exists K \in [1,p], \exists\, (j,i) \in [1,N] / \beta_j^k \neq \beta_i^k \qquad (10)$$

So as to test the Homogenous Causality Hypothesis (HCH), we have to compute the following F statistics:

$$F_{HCH} = \frac{(RSS_3 - RSS_1)/[p(N-1)}{RSS_1 / [NT - N(1+p) - p]} \qquad (11)$$

Where,

RSS$_3$ belonging to the realization of the residual sum of squares obtained from model (1) when one imposes the homogeneity for each lag *k* of the coefficients associated to the variable $X_{j,t\text{-}k}$. If the **F$_{HCH}$** statistics[1] is not significant, the null hypothesis is accepted. This result implies that the variable *x* is causing *y* in the N cross sectional unit, and that the autoregressive processes are completely homogenous.

Heterogeneous Causality Hypothesis (HECH)

After rejecting Homogenous causality hypothesis the third case corresponds to the heterogeneous causality hypothesis (HECH) in which we first assume that there exists at least one individual causality relationships (and at the most N), and second that individual predictors, obtained conditionally to $\overline{y}_{j,t}, \overline{x}_{j,t}, \overline{\lambda}_t$ and α_j, are heterogeneous.

$$\exists_j \in [1,N]\, E(y_{j,t} / \overline{y}_{j,t}, \alpha_j) \neq E(y_{j,t} / \overline{y}_{j,t}, \overline{x}_{j,t}, \alpha_j) \qquad (12)$$

$$\exists (j,i) \in [1,N]\, E(y_{j,t} / \overline{y}_{j,t}, \overline{x}_{j,t}, \alpha_j) \neq E(y_{i,t} / \overline{y}_{i,t}, \overline{x}_{i,t}, \alpha_i) \quad (13)$$

Heterogeneous Non-Causality Hypothesis (HENCH)

Finally, Heterogeneous Non-Causality Hypothesis (HENCH) assumes that there exists at-least one and at most N-1 equalities of the form:

---

[1]with P(N−1) and NT−N(1+P)−P degrees of freedom

$$\exists \in [1,N] \, E(y_{j,t} \, / \, \overline{y}_{j,t}, \alpha_j) = E(y_{j,t} \, / \, \overline{y}_{j,t}, \overline{x}_{j,t}, \alpha_j) \qquad (14)$$

For this Heterogeneous Non-Causality Hypothesis (HENCH) the mechanism is given as

$$H_o : \exists j \in [1,N] \, / \, \forall k \in [1,p] \, \beta_j^K = 0 \qquad (15)$$

$$H_a : \forall j \, \varepsilon \, [1,N], \exists K \, \varepsilon \, [1,N] \, / \, \beta_j^K \neq 0 \qquad (16)$$

It is suggested here to test this Heterogeneous Non-Causality Hypothesis with two nested tests. The first test is an individual test realized for each individual. For each individual j = 1… N, we test the nullity of all the coefficients of the lagged explanatory variable $x_{j,t\text{-}k}$. Then, for each α, we test the hypothesis $\beta_j^K = 0, \forall k \in [1,p]$.

$$F_{HENCH}^j = \frac{(RSS_{2,j} - RSS_1) \, / \, p}{RSS_1 \, / \, \left[NT - N(1+2p) + p \right]} \qquad (17)$$

Where, $RSS_{2,j}$ is belonging to the realization of the residual sum of squares obtained from model (1) when one imposes the nullity of the k coefficients associated to the variable $x_{j,t\text{-}k}$ only for the individual *j*. These N individual tests allow us to identify the individual for which there is no causality relationship.

A second test consists in testing the joint hypothesis that there is no causal association for a sub group of individuals. Let us respectively denote

I_c = the index sets corresponding to sub-groups for which there exists a causal relationship

I_{nc} = the index sets corresponding to sub-groups for which there does not exist a causal relationship. In other words, we consider the following model $\forall_t \in [1,T]$:

$$y_{j,t} = \sum_{k=1}^{p} \gamma_j^k y_{j,t-k} + \sum_{K=0}^{p} \beta_j^k x_{j,t-k} + V_{j,t} \qquad (18)$$

With

$$\beta_j^K \neq 0 \; for \; j \in \, I_c$$
$$\beta_j^K = 0 \; for \; j \in \, I_{nc}$$

We compute following Wald statistics to test this hypothesis:

$$F_{HENCH} = \frac{(RSS_4 - RSS_1) \, / \, (n_{nc} p)}{RSS_1 \, / \, \left[NT - N(1+p) - n_c p \right]} \qquad (19)$$

Where,

RSS_4 belonging to realization of the residual sum of squares acquired from model (1) when one imposes the nullity of the k coefficients associated to the variable $x_{j,t\text{-}k}$ for the n_{nc} individuals of the I_{nc} sub-group.

In case of accepting null hypothesis there exists a sub-group of individual for which the variable *X* does not cause the variable *y*. The dimension of this sub-group is then equal to n_{nc}. In contrast, if the null hypothesis is rejected, it implies that there exists causality relationship between *x* and *y* for all individuals of the panel. This study uses the panel causality test proposed by Dumitrescu and Hurlin. This test allows taking into account heterogeneity in two dimensions, the heterogeneity of the regression model and secondly heterogeneity of the causal relationships. Heterogeneity of the model is that each cross section or individual is different from the other whereas there is a causal relationship among variables, say x and y, for all individuals. Heterogeneity of the causal relationship refers to existence of homogenous or heterogeneous causality [15].

The linear model for this study is defined as:

$$ECS_{jt} = \sum_{i=1}^{n} \alpha_i \, TO_{jt-k} + \sum_{i=1}^{n} \beta_i \, ECS_{jt-k} + \mu_{1t} \qquad (20)$$

$$TO_{jt} = \sum_{i=1}^{n} \gamma_i \, ECS_{jt-k} + \sum_{i=1}^{n} \delta_i \, TO_{jt-k} + \mu_{2t} \qquad (21)$$

Where

ECS = Economic city size

TO = Trade Openness

j represent the cross sectional unit, that is, city (j=1,... ,14), t shows time and k is the number of lags (k =1,.....n).

These two variables are stationary variables for 14 cross sectional units in 14 time periods $\beta_i = (\beta_i^1, ... \beta_i^k)$ and the individual effects α_i are assumed time invariant. Further, it assumes that lag orders of *K* are identical for all cross-section units of the panel and the autoregressive parameters $\partial_i^{(k)}$ and regression coefficients $\beta_i^{(k)}$ vary across groups. The null hypothesis considers the assumption of homogenous non causality hypothesis (HNC) which implies that no individual causality relationship between variables exists. Symbolically

$$H_o : \beta_j = 0 \quad \forall j = 1 \ldots N \tag{22}$$

The alternative hypothesis is specified as Heterogeneous non causality (HENC) hypothesis. Under this hypothesis we assume that there exist causality between the variables for at-least one and at most (N-1) cross-sectional units. Hence there are two sub sets of the total cross sections (N). Among these two sub groups, one with N2 number of cross section there exist a causality relationship between the variable under consideration while for N1 cross sections in the other sub group there is no causality running from one variable to another. Symbolically,

$$H_1 : \beta_j = 0 \quad \forall j = 1, \ldots, N \tag{23}$$

$$\beta_j \neq 0 \quad \forall j = N_1 + 1, \ldots, N \tag{24}$$

Where $\beta_j = 0$ for the sub group with cross sections for which no causality exist while $\beta_j \neq 0$ for the sub group with cross sectional unit for causality exists. N1 is unknown that is number of cross section in this N1 sub set is not known though it satisfies the condition that this group holds equal or greater than zero cross sections and is either equal or less than total cross section in the data set i.e $0 \leq \frac{N_1}{N} < 1$. This ratio (N1/N) is compulsorily less than 1 because if N1 become equal to N it indicates that there is no causality among the variables for any of the cross sectional units, thus, it becomes equivalent to non-causality null hypothesis. And if this ratio is 0 it reflects causality between the variables in all cross-sectional unit.

Here, under the alternative hypothesis this test assumes that there are N1 < N cross-sections for which there is no causality flowing from one variable to another. That is rather testing non causality against causality as the alternative hypothesis; here in the null hypothesis check non-causality in all cross sectional units while in the alternative non-causality in a sub group of cross-section is test which in turn means there exist causality in the other sub group of cross sectional units.

This test performs causality check for individual cross section using Walt test and then averages out the Walt statistics. The average statistics $W_{N,t}^{HNC}$ associated with null hypothesis is defined as

$$W_{N,t}^{HNC} = \frac{1}{N} \sum_{j=1}^{N} W_{j,t} \tag{25}$$

Where $W_{j,t}$ stand for the individual Wald statistics for the jth cross sectional unit corresponding to the

individual test ($H_o : \beta_j = 0$). The panel statistic sequentially converges under the HNC hypothesis to a normal distribution, when *T* tends to infinity first and then *N* tends to infinity. Using a standardized statistic, $Z_{N,t}^{HNC}$ the homogeneous non-causality (HNC) hypothesis is rejected if, $Z_{N,t}^{HNC}$ is larger in absolute value than the corresponding normal critical value for a given level of significance.

5. DATA SOURCES AND VARIABLE CONSTRUCTION

To perform the analysis City level data for the core variables of the research is not available from any secondary source so despite of qualifications attached with various statistical technique and disaggregation procedures the study ought to use the similar techniques to explore the gray area of city level research. The data for the construction of required variable is mainly extracted from Com-trade (united nations), Censes of Manufacturing Industries, Statistical Year Book and Labour Force Survey (Pakistan bureau of statistics) of Pakistan.

5.1. Construction of Economic City Size

The city's economic size is best reflected from its contribution in Real Gross Domestic Product (RGDP) of a nation. In Pakistan city level GDP data is not readily available from secondary sources thus using top down approach the national level GDP disaggregate at city level.

The methodology used for generating city level RGDP is stated below.

Estimation of Gross Domestic Product (GDP) at City Level[2]

City level real GDP is calculated using top-down approach, a statistical technique, for disaggregating the annual aggregate value of sector-wise real GDP using a suitable base for this disaggregation. These sectors include agriculture, manufacturing and services. For obtaining City-wise real GDP production of these three sectors is added up at City level as per production method for GDP measurement.

Deciding Base for Disaggregation

The base of disaggregation, industry-wise employment, is suggested by the very basic production

---

equation regarded as a corner-stone in the foundation of production theory. Consider the Cobb-Douglas production function.

$$Y = AL^{\alpha}K^{1-\alpha} \qquad (26)$$

Here A is the factor productivity, α is the labour share, (1-α) is the share of capital and *K* and *L* are the labour and capital respectively. As capital is fixed in short-run, labour became the base for disaggregation which tends to be considered even a stronger base for disaggregation when it is applied to labour abundant countries like Pakistan.

Production of industry belongs to the sector mentioned above is also dependent upon the same production function as

$$RGDP_S = \sum_{j=1}^{n} K_j L_j \qquad (27)$$

Here,

$RGDP_S$ = Real GDP of sector s

K_j = Capital in industry j

L_j = labour employed in industry j

Estimation of GDP

After identifying the base for disaggregation, estimation of district-wise real GDP was conducted as per the formulation below

$$RGDP_{ct} = \sum_{S=1}^{3} \frac{RGDP_{st}}{L_{st}} * L_{stc} \qquad (28)$$

Subject[3] to

$$\sum_{c=1}^{n} RGDP_{stc} = RGDP_{st} \qquad (29)$$

Here s stand for sector, *c* for city and t is for year.

5.2. Construction of Trade Openness

Regarding openness there are various indicators that can be used to measure trade liberalization. The first one is about trade policies, such as tariff and non-tariff barriers but these measures are not free from measurement errors. Especially, if ratio of tariff revenues to import is used as a measure this might be

misleading because they tend to underestimate the actual rate of tariff. Pritchett and Sethi reported the extensive divergence among collected rates and official tariff rates [38]. Several studies have analyzed the relationship between GDP and average tariff rate. They found mixed results; some studies reported a significant negative relationship [16, 20. 32] however others established very weak relationship between them [10, 45].

Some studies used the ratio of manufacturing output to GDP as a measure of trade openness. The supportive arguments they give in this regards is that the open economies can access advanced superior technology easily to flourish productivity of using sector which is usually a manufacturing sector [12, 14]. Moreover population densities also used as a measure of trade openness due to the belief that the regions which have greater population density are more probable to be open and they have greater contacts internationally [43, 44].

The trade to GDP ratio is the most widely used measure of trade openness and trade policies. The intuitively tempting trade ratio is often calculated as:

$$TO = \frac{Export + Import}{GDP} \qquad (30)$$

This research also uses the same trade ratio as a measure of trade openness because of their relative importance. The formulation of trade openness ratio demands city-wise data for imports and export which is not available but industry wise import and export data is available at country level. Hence it had to be generated using industry-wise establishments engaged in production in city j. Imports / exports for cities are calculated by summing their industry-wise share in total import / exports by individual industries on the basis of share of establishments belonging to all industries in city j out of the total establishments belonging to all industries in the country.

Following equations are used to generated exports and import by cities under consideration.

For Export

$$EX_J = \sum_{i=1}^{n} \frac{S_{ij}}{S_i}(EX_i) \qquad (31)$$

Where:

EX_J = Total export of city (j).

S_{ij} = Total no of industrial establishment (i) in city j.

S_i = Total no of industrial establishment (i) in all cities.

EX_i = Total export of establishment i.

Greater number of industrial establishments in a city would result in more production by city for local consumption and export purposes.

For import

$$IM_J = \sum_{i=1}^{n} \frac{S_{ij}}{S_i} (IM_i) \qquad (32)$$

Where:

IM_J = Total import of city (j).

S_{ij} = Total no of industrial establishment (i) in city j.

S_i = Total no of industrial establishment (i) in all cities.

IM_i = Total import of establishment i.

Production needs inputs that are locally available as well as those that have to import from abroad. Thus with more industrial establishment locating in a region more materials from abroad are expected to be imported.

6. EMPIRICAL RESULTS

The preliminary step of empirical analysis is concerned with exploring the degree of integration of each series. Therefore to scrutinize the stationarity properties of the individual data series the unit root test of Phillips & Perron [37] and augmented Dickey-Fuller [13] test has been employed. In case the series are not stationary at level, first differencing is performed to make them stationary followed by a panel co-integration test and finally panel causality test is executed. Results of the panel unit root test, presented in Table **1**, affirm that both of the series are stationary at level as per the majority of the test statistics. Hence eliminating the need for differencing and co-integration testing and thus causality analysis is directly performed afterwards because for causality analysis series should be stationary, differencing and co-integration is not required.

As the panel used in this research is of heterogeneous nature, panel causality test proposed by Dumitrescu Hurlin for heterogeneous panel datasets is employed. The proposed test takes heterogeneous non-causality as its alternative hypotheses against the null hypothesis of homogenous non-causality (HNC). Homogenous non-causality is the case when there is no causal relationship between trade openness and economic city size for not even a single cross-sectional unit i.e city in this case. Heterogeneous non-causality implies that no causality among the two variables exist for all cross sectional units rather there exist a causal relationship between TO and ECS for at least one and at most (N-1) cross sectional units [15]. The test results for panel causality analysis are presented in the Table **2**.

The test result affirms the existence of bidirectional causality between the degree of trade openness and economic size of a city. Both series positively cause each other supporting Romer's view. With more

Table 1: Summary of Panel Unit Root Test

Method	With Constant (At level)		With Constant & Trend (At level)	
Null: Unit root (assumes Common unit root process)	**Trade Openness**	**Economic City Size**	**Trade Openness**	**Economic City Size**
Levin, Lin & Chu	-14.8001*	-9.65274*	-10.73*	-8.43158*
Breitung t-stat			-5.862*	-5.45409*
Null: Unit root (assumes individual unit root process)	**Trade Openness**	**Economic City Size**	**Trade Openness**	**Economic City Size**
Im, Pesaran and Shin W-stat	-10.0856*	-5.80977*	-6.1964*	-2.90974**
ADF - Fisher Chi-square	134.709*	80.5566*	88.1259*	47.4482***
PP - Fisher Chi-square	143.649*	108.540*	252.077*	54.1407**

Note: *Statistics those are significant at less than 1% level.
**Statistics those are significant at less than 5% level.
***Statistics those are significant at less than10% level.

Table 2:   Dumitrescu Hurlin Panel Causality Test Results

Pair wise Dumitrescu Hurlin Panel Causality Tests		
Sample: 2000 2013	Lags: 2	
Null Hypothesis:	W-Stat.	Zbar-Stat.
LNTO does not homogeneously cause LNGDP	0.86222	-1.69520**
LNGDP does not homogeneously cause LNTO	0.16899	-2.30165*

Note: *Statistics those are significant at less than 5% level.
**Statistics those are significant at less than 10% level.

openness a region tend to have more exposure to recent and advanced technologies, increased accessibility to raw material and world market, even with trade openness raw material that is relatively expensive domestically can be acquired at a cheaper rate leading to decreased production cost and increased production which might lead to increased exports as well [8, 34]. On the other side of the coin, with increased economic size, a city become more efficient in production of goods and services, economizes on unit production cost and increases quality enhancing exports and foreign exchange earnings. Per capita income also increases as a result of increased efficiency by the city which in turn increases the import demand by the city too. All these activities further open a city towards trade.

7. CONCLUSIONS

This chapter investigates the link between degree of trade openness and economic city size. After reviewing theoretical and empirical literature regarding this issue it is found clear that there exists a causal link between economic city size and trade openness. Therefore to explore, whether trade openness cause economic city size or economic city size cause degree of openness or there is a bidirectional link between these two the panel causality analysis for major cities of Pakistan is carried out on the basis of annual data set from 2000 to 2013. At the first step, test for stationary is performed and as both series are found stationary at level the need for differencing and co-integration testing is no longer required and thus causality analysis is conducted next. Considering the heterogeneous nature of panel data set causality test proposed by Dumitrescu Hurlin is employed. The results suggest that the causality among trade openness and economic city size run in both directions. This is in line with Romer and Harrison views that more liberal trade policies do precede higher growth of region but higher growth also encourage degree of trade openness [20, 41].

Trade openness influences city size by increasing its exposure and access to advance technologies and international market for imports and exports. On the other hand, economic size causes trade openness via economies of scale in production as a result of which a city becomes more competitive in terms of unit cost and quality facilitating exports. Foreign trade plays essential role in the process of growth and development of a region. Export and import have a significant impact in expanding the size of major cities of Pakistan. The policy maker should take into consideration this piece of research while formulating polices about growth. Government should facilitate those industries which are export oriented like agro based industries to increase foreign exchange earnings. This foreign exchange earning that can be used to established new industries that required foreign inputs and also discourage monopolies.

ANNEXURE

Table A1: Summary of Descriptive Statistics

Descriptive Summary	ECS	TO
Mean	89221.91	1.676983
Median	39321.80	1.394949
Maximum	606593.3	6.567320
Minimum	9504.107	0.139851
Std. Dev.	128163.1	1.240000
Skewness	2.446847	1.361759
Kurtosis	8.289061	5.202520
Jarque-Bera	424.0330	100.1940
Probability	0.000000	0.000000
Sum	17487494	328.6886
Sum Sq. Dev.	3.20E+12	299.8320
Observations	196	196

Table A2: Lag Selection for Panel Causality Analysis

Criteria Selected	LnECS	LnTO
Akaike Info Criterion	2	2
Schwarz Info Criterion	2	2
Hannan-Quinn Criterion	2	2
Modified Akaike Info Criterion	2	2
Modified Schwarz Info Criterion	2	2
Modified Hannan-Quinn Criterion	2	2
t-statistic	2	2

REFERENCES

[1]   Ades AF, Glaeser EL. Trade and circuses: Explaining urban giants. Quarterly Journal of Economics 1995; 110(1): 195-227.
https://doi.org/10.2307/2118515

[2]   Ahmad J, Kwan ACC. Causality between Exports and Economic Growth Empirical evidence from Africa. Economics Letters 1991; 37(3): 243-248.
https://doi.org/10.1016/0165-1765(91)90218-A

[3]   Alonso V. Spatial Distribution of Production and International Trade: A Note, Regional science and Urban economics 1999; 29: 371-380.
https://doi.org/10.1016/S0166-0462(98)00041-6

[4]   Awokuse TO. Causality between exports, imports, and economic growth: Evidence from transition economies, Economics Letters 2007; 94(3): 389-395.
https://doi.org/10.1016/j.econlet.2006.08.025

[5]   Behrens K, Gaigne C, Ottaviano GIP, Thisse JF. Countries, Regions and Trade; on the welfare impacts of economic integration, European Economic Review 2007; 51(5): 1277-1301.
https://doi.org/10.1016/j.euroecorev.2006.08.005

[6]   Bouoiyour J. Trade and GDP Growth in Morocco: Short-run or Long-run Causality, Brazilian Journal of Business and Economics 2003; 3(2): 14-21.

[7]   Brulhart M. The spatial effects of trade openness: a survey, Rev World Econ 2011; 147: 59-83.
https://doi.org/10.1007/s10290-010-0083-5

[8]   Chang R, Kaltani L, Loayza N. Openness is Good for Growth: The Role of Policy Complementarities, Journal of Development Economics 2009; 90: 33-49.
https://doi.org/10.1016/j.jdeveco.2008.06.011

[9]   Chow P. Causality between exports growth and industrial development, Journal of Development Economics 1987; 26: 55-63.
https://doi.org/10.1016/0304-3878(87)90051-4

[10]   Clemens MA, Williamson JG. A tariff-growth paradox? Protection's impact the world around, NBER Working Paper Series No. 8549, 2001.

[11]   Dar A, Amirkhalkhali S. On the impact of trade openness on growth: Further evidence from OECD countries. Applied Economics 2003; 35(16): 1761-1766.
https://doi.org/10.1080/0003684032000129020

[12]   Das KD. Trade Liberalization and Industrial Productivity: An Assessment of Developing Country Experiences, Indian Council for Research on International Economic Relations, Working 2002; Paper No. 77, 2002

[13]   Dickey D, Fuller W. Distribution of the Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association 1979; 74: 427-431.

[14]   Dollar D. Outward-oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs. Economic Development and Cultural Change 1992; 40(3): 523-44.
https://doi.org/10.1086/451959

[15]   Dumitrescu E, Hurlin C. Testing for Granger non-causality in heterogeneous panels. Economic Modelling 2012; 29(4): 1450-1460.
https://doi.org/10.1016/j.econmod.2012.02.014

[16]   Edwards S. Openness, productivity and growth: what do we really know?" Economic Journal 1998; 108: 383-398.
https://doi.org/10.1111/1468-0297.00293

[17]   Gabaix X. Ioannides YM. The Evolution of City Size Distributions, working paper. Department of Economics Tufts University, 2003.

[18]   Granger CWJ. Investigating Causal Relations by Econometric Models and Cross-spectral Methods. Econometrica 1969; 37(30): 424-438.
https://doi.org/10.2307/1912791

[19]   Gries R. Trade Openness and Economic Growth: A Panel Causality Analysis". Centre of International Economics Working Paper Series, No. 2011-06, 2012.

[20]   Harrison A. Openness and Growth: a time series, cross-country analysis for developing countries. Journal of Development Economics 1996; 48: 419-447.
https://doi.org/10.1016/0304-3878(95)00042-9

[21]   Henderson JV. The Sizes and Types of Cities. American Economic Review 1974; 64: 640-657.

[22]   Henderson JV. Systems of Cities in Closed and Open economies. Regional Science and Urban Economics 1982; 12(3): 325-350.
https://doi.org/10.1016/0166-0462(82)90022-9

[23]   Hsiao MW. Tests of Causality and Exogeneity between Export Growth and Economic Growth. Journal of Economic Development 1987; 12: 143.159.

[24]   Hurlin C, Venet B. Granger Causality tests in Panel data models with fixed coefficient, Working Paper Eurisco University Paris IX Dauphine, 2001.

[25]   Idris J, Yusop Z, Habibullah M. Trade openness and economic growth: a causality test in panel perspective. International Journal of Business & Society 2016; 17(2): 281-290.

[26]   Islam MN. Export expansion and economic growth: testing for co-integration and causality. Applied Economics 1998; 30(3): 415-425.
https://doi.org/10.1080/000368498325930

[27]   Jung W, Marshall P. Exports, growth and causality in developing countries. Journal of Development Economics 1985; 18: 1-12.
https://doi.org/10.1016/0304-3878(85)90002-1

[28]   Krueger A. The experiences and lessons of Asia's super exporters. In V. Corbo, A. Krueger, & F. Ossa (Eds.), Exports-Oriented Development Strategies: The Success of Five Newly Industrialising Countries. Boulder, CO: Westview Press, 1985.

[29]   Krugman PR Urban Concentration: The Role of Increasing Returns and Transport Costs, Conference Paper. World Bank Annual Conference on Development Economic 1994.

[30]   Krugman PR. The self-organizing Economy. Oxford Blackwell Publishers, 1996.

[31]   Krugman PR, Elizondo RL. Trade Policy and Third World Metropolis. Journal of Development Economics 1996; 49: 137-150.
https://doi.org/10.1016/0304-3878(95)00055-0

[32]   Lee JW. International trade, distortions, and long-run economic growth. IMF Staff Papers 1993; 40 (2): 299-328.
https://doi.org/10.2307/3867316

[33]   Liu X, Burridge P, Sinclair PJN. Relationships between economic growth, foreign direct investment and trade:

Evidence from China". Applied Economics 2002; 34(11): 1433-1440.
https://doi.org/10.1080/00036840110100835

[34]   Mill ES, Song BN. Urbanization and Urban Problem, Harvard University Press, Cambridge, 1979.
https://doi.org/10.2307/j.ctt1tg5jv2

[35]   Moomaw RL, Shatter AM. Urbanization and economic development: A bias toward large cities. Journal of Urban Economics 1996; 40(1): 13-37.
https://doi.org/10.1006/juec.1996.0021

[36]   Perera-Tallo F. Growth Due to Globalization". International Economic Review 2003; 44: 651-676.
https://doi.org/10.1111/1468-2354.t01-1-00084

[37]   Phillips PCB, Perron P. Testing for Unit Roots in Time Series Regression, Biometrika 1988; 75: 335-346.
https://doi.org/10.1093/biomet/75.2.335

[38]   Pritchett L, Sethi G. Tariff rates, tariff revenue, and tariff reform: some new facts. The World Bank Economic Review 1994; 8 (1): 1-16.
https://doi.org/10.1093/wber/8.1.1

[39]   Rauch JE. Reconciling the pattern of trade with the pattern of migration, American Economic Review 1991; 106: 775-796.
https://doi.org/10.3386/w3605

[40]   Ricardo D. On the Principles of Political Economy and Taxation. Batoche Books, Canada 1817.

[41]   Romer D. Openness and Inflation: Theory and Evidence. Quarterly Journal of Economics 1993; 108(4): 870-903.
https://doi.org/10.2307/2118453

[42]   Rosen KT, Resnick M. The size distribution of cities: An examination of the Pareto law of primacy. Journal of Urban Economics, 1980; 8(2): 165-186.
https://doi.org/10.1016/0094-1190(80)90043-1

[43]   Sachs JD, Warner AM. Natural resource abundance and economic growth. Center for International Development and Harvard Institute for International Development 1995.
https://doi.org/10.3386/w5398

[44]   Sachs JD, Warner AM. Fundamental sources of long-run growth. American Economic Review 1997; 87: 184-188.

[45]   Sala-i-Martin XX. I just ran two million regressions. American Economic Review 1997; 87(2): 178– 183.

[46]   Vamvakidis W. How Robust is the Growth-openness connection? Historical Evidence" Journal of Economic Growth 2002; 7: 57-80.

[47]   Wacziarg R. Measuring the Dynamic Gains from Trade. World Bank Economic Review 2001; 15(3): 393-429.
https://doi.org/10.1093/wber/15.3.393

[48]   Zhewei H, Can Z. The Impact of Trade Openness on Urbanization – a study of Eastern China" Bachelor Thesis in Economics 2009.