The causal nexus between imports and economic growth in China, India and G7 countries: granger causality analysis in the frequency domain

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ABSTRACT

This research examine the causal nexus between imports and economic growth in China, India and G7 economies. We use BC granger causality analysis in the frequency domain short (temporary) and long term (permanent) causality. Our results suggested that, there is a frequency domain (high and low) proof of the bi-directional causal nexus between imports and economic growth. The imports and economic growth in most economies seem to be long-term and short-term dependent. This empirical study shows that policymakers of these big economies need to analyze the transformation in the import-economic growth causality robustness throughout the year when planning policy actions.

1. Introduction

A country frequently requires to import with the purpose of obtain transitional productivity inputs and manufactured merchandise for national productivity and national consumption, respectively. “Imports led growth (ILG)” shows that economic growth might be mainly determined by imports growth. "Endogenous growth model" indicates that imports can be the medium for long-term economic growth, as it gives local enterprises the opportunity to obtain the required intermediary and international high-tech (Coe and Helpman, 1995). Import growth may act like a channel in order to shift of growth promoting global R&D expertise from rich to poor economies (Lawrence and Weinstein, 1999; Mazumdar, 2000). As a medium to transmit technology and innovation, imports provide accessibility to wealth and intermediate products, and enhance challenges to make sure a persuasive allocation of resources (Tsegaye, 2015).

Imports initiate spillage in the circular stream of revenue, which is considered to be the main reason of unemployment rather than economic growth (Li et al., 1997). As a result, certain countries shield domestic markets from rivalry with international manufacturers. However, the endogenous growth model shows that imports are crucial in a country’s growth process. When imports collided with exports, it revealed the leading role of imports in economic growth, thus growth is export-oriented and imports are export-oriented (Awokuse, 2007, 2008); (Shan and Sun, 1998bib_Awokuse_2008). The trend of import driven economic growth has further emerged as domestic import substitution businesses struggle with international rivals in developed countries (Kim et al., 2007).

To making good trade polices it’s very important to understand the causal nexus between imports and economic growth. For example, if imports trade fails to support economic growth, countries may be more willing to follow import substitute trade policy. However, the implementation of import substitute policy may promote economic growth. After eliminating import substitute policy and utilizing import liberalization trade policy, the largest part of Asian economies cautiously feel the favorable cause of import (Nguyen, 2011). According to Kim et al. (2007), they believe that imports liberalization policies promote the growth of an economy.

Previous studies used variations of the Granger causality (GC) across the "time-domain" to present facts of causal correlation between imports and economic growth, which purport not so exhortative because they couldn’t explain the possible modifications in the dynamics of causality in the long term. The GC test in time domain did not consider the possible change of causality dynamics with time, because they strictly assumed the linearity of vector auto-regression (VAR) system Opoku et al. (2019). The “frequency domain or spectral Breitung and Candelon (BC) causality test”, created by Breitung and Candelon (2006), related to the prior study of Hosoya (1991) and Geweke (1982). The major dissimilarity between the time domain and the Spectral or frequency domain approach is that the “time-domain” demonstrates when a definite change
happens between the time-series, while the ‘frequency domain’ evaluates
the level of a definite change in the time-series. In a short-series of
analysis, serial patterns perhaps vital and the frequency domain allows
the exclusion of these variations. In addition, the frequency-domain
approach allows examining nonlinear and causal cycles, i.e., causal
relationships at high or low frequencies (Gokmenoglu et al., 2019).
However, some scholars investigate the causal effects between energy and
economic, according to Sivaram and Saha (2018), energy is the means of
support of countries economy, and a permanent energy supply is
important for feasible economic growth and state security. Su et al.
(2021a,b) studied the linkage between geopolitical risk and renewable
energy. Their results demonstrated that there was no causal nexus be-
tween geopolitical risks and renewable energy. On the other hand, the
results crosswise different sub-samples illustrated the bidirectional
causal relationship between geopolitical risk and renewable energy.
Geopolitical risks have both positive and negative impacts on renewable
energy, indicates that geopolitical risk plays a vital part in the develop-
ment of renewable energy. In addition, the global economic growths,
technological process in fossil fuels and the continuous improvement of
environmental engagements have fostered the growth of renewable en-
ergy, which accommodates novel forces and hives rivalry.
Therefore, advanced fiscal organisations are a way to promote growth
in economic and get rid of the curse of rent resource (Shahbaz et al.,
2018a,b). Zaidi et al. (2019), used the panel data on OECD economies
from 1990 to 2016 to analyze the impact of human capital (HC), natural
resources, globalization and economic growth on financial development
and predicted that economic growth, capital formation; globalization,
natural resources and human capital had a significant impact on financial
development. Human capital impacts to the productive resort natural
resources, the consistency of the financial system and economic growth
(Becker, 2009; Zaidi et al., 2019). J. Guan et al. (2020), further thor-
oughly investigated the linkage between the financial development and
natural resources rents, systematically and analytically, so as to supply to
the expansion of financial growth policies in China. Their research
explored the cause of natural resources rents, economic growth, human
capital, and globalization on financial development from 1971 to 2017.
The findings of their empirical research presented notable proof for the
nexus between financial development and its factors are co-integrated.
Their results proposed that there is a resource curse in China, because
research has proved that natural resources rents are the main indicators
for the corrosion of financial development, because they will contribute
to short and long-run financial growth.

With the implementation of maritime power strategy, numerous
kinds of studies investigate the linkage between financial development
and marine economic growth of China (He et al., 2019; Tian et al., 2019).
However, Su et al. (2021a,b) investigated the causal relationships be-
tween China’ financial development and marine economic growth. The
influences of financial development on marine economic growth differ
from province to province. Furthermore they studied the influence of
regional dissimilarities on the comprehensive marine economic growth;
the results indicated that there were substantial regional dissimilarities in
the causality of the three marine industries. Zhang et al. (2021) explore
the causal relationship between carbon dioxide (CO2) emission and GDP
to investigate the efficacy of the EKC theory in P.R. China. The study
utilized full sample granger causality test. The findings demonstrated that
the GDP had positive impact on carbon dioxide (CO2) emission, but
the carbon dioxide (CO2) emission have no affect on GDP. On the other
hand, there were not causal effects between carbon dioxide (CO2)
emission and GDP growth. Research scholars and experts believe that the
key issue of greenhouse gas emissions, especially CO2 emissions is global
warming. Umar et al. (2020a,b) and Zhang et al. (2021), concluded reverse
U-shape linkage between the GDP per capita, and the emission
per capita of three contaminant. As a result, a long term causal linkage
between GDP and use of energy, while this was not the case in China.

Yuan et al. (2008) and Umar et al. (2020a,b). As the most populous
country on the earth, the results showed that China is one of the countries
with the biggest contributor of carbon dioxide (CO2) in the environment
(Umar et al., 2020a,b). A general opinion is that the economic growth
and energy consumption are majority significant factors that influencing
carbon dioxide (CO2) emissions (Zhu et al., 2016; Cevik et al., 2020;
Shakeel and Ahmed, 2021; Umar et al., 2021). Therefore, the other study
direction involved the causality test between carbon dioxide (CO2)
emissions and economic growth. The scientific research results showed
ambiguity, because there is no integrated finding on the linkage between
carbon dioxide (CO2) and economic growth (Umar et al. (2020).

Aluko and Obalade (2020), studied the relationship between imports
(imports of goods and services (US$)) and economic growth (GDP) in a
sample of 26 African economies from 1990 to 2015 under the umbrella of
neoclassical production function. Using Toda &Yamamoto (1995)
Granger non causality test, their research findings illustrate that there is
no causal effects between import and economic growth in more than half
of the countries, which proves that the causality is not exist between
import and economic growth. Correspondingly, Aluko and Adeyeye
(2020) tested the causal relationship between imports and economic
growth in 41 African economies. Their research findings show that the
uni-directional causality exists between import and economic growth,
and the uni-directional causality found between economic growth and
import in a few countries, the neutrality hypothesis is effective in the
short and long term in most countries. Likewise, Maitra (2020) examined
India's ILG hypothesis in the post reform era. His study discovered sig-
nificant proof confirming the ILG hypothesis in the short and long term,
indicating that imports have an important influence on India's economic
growth.

We use time series model to study the causal nexus between imports
(imports of goods and services (current US dollar), and economic growth
(gdp per capita (constant 2010 US dollar) of China, India and G7 coun-
tries, so as to increase the insufficient empirical facts of the countries. We
test the Granger causality between imports and economic growth using
the frequency domain method, which presents new proof for the scien-
tific literature. In the frequency domain, we use Breitung and Candelon's
(2006), BC Granger causality test, which enables us to identify the causal
effect between imports and economic growth in different period in the
framework of bivariate VAR model. It is essential to execute GC test in the
frequency domain Lemmens et al. (2008), consequently, it also be able to
produce new additional understanding into causality as compared with
the conventional Granger causality test.

Because of trade cycles, policy and radical changes, robustness of
causal correlations between imports and economic growth may change
after some period of time. Therefore, through the use of spectral analysis
or frequency domain approach of GC, it’s extremely vital to elucidate
the potential changes of the causality robustness between imports and eco-
nomic growth ultimately. Our research is mainly helpful for policy-
makers to applicable the short-term and long-term causal linkage
between import and economic growth in China, India and G7 (Canada,
France, Germany, Italy, Japan, UK, USA) economies under analysis.

The rest of this article is as follows. Section 2 consists of literature
review. The methodology and data collection are discuss in Section 3.
Section 4 and 5 discusses the results of the analysis, and presented
conclusion.

2. Literature review

The plethora studies present facts to observe the role of imports and
economic growth, and export analysis -export growth hypothesis. Awo-
kuse (2007), referred that neglecting the role of imports and exagger-
ating on exports as the major factor on growth may mislead or be
insufficient for growth analysis. Yet, if there is a one-way correlation
between exports and imports, it depends on import growth (). Hence,
ignoring imports in the analysis may decline the factual trade influence on economic growth. High income countries demonstrate the imports-led growth hypothesis, while lower income economies demonstrate two-way correlation (Islam et al., 2012). If economies have satisfactory foreign exchange reserves, economic growth possibly is reinforced by importing goods and services for consumption and manufacture purposes (Baharumshah and Rashid, 1999).

The causality between the variables can be classified by four hypotheses: (1) imports-led growth (ILG) hypothesis (2) growth-led imports (GIL) hypothesis (3) feedback (FB) hypothesis and (4) neutrality (NH) hypothesis. According to the ILG hypothesis, any economy imports fix assets and high-tech products, which added results in the expansion of industrial infrastructure and alternately stimulate economic growth (Hanson and Trewavas, 1982). The ILG hypothesis medium ascertain long-term economic growth, thus it presents the essential intermediate raw materials and universal cutting-edge technology for domestic industries (Coe and Helpman, 1995).

On the other hand GLIH hypothesis holds that economic growth boosts import desire, indicating that imports are triggered by economic growth (EC). Such proposition/hypothesis carries that the control of causal relationship following economic growth to import. The FB proposition/hypothesis shows that the GLIH hypothesis and the ILG hypothesis prevail as well. This paper points out that two-dimensional causal correlation between import and economic growth exist, which shows that import and economic growth promote together. Nevertheless, the neutral hypothesis is just the converse of the feedback hypothesis, because it does not support the ILG hypothesis or the GLIH hypothesis as well. However it shows that there will have no causation between import and economic growth variables. The facts supporting the above hypothesis have been demonstrated in experimental studies. Thereby peculiarity of some studies, a significant methodological technique pointed out in the research articles is the utilization of granger causality test.

Our research is especially valuable for decisions makers to understand the short (temporary) and long term (permanent) robustness of causal nexus between imports and economic growth in China, India and G7 (Canada, France, Germany, Italy, Japan, UK, USA) economies. We will utilize the time series modelling technique to analyses the causality effect between imports and economic growth of China, India and G7 member countries, therefore extending the sparse empirical facts of most of the countries under analysis. The “frequency domain” method practiced to inspect the GC causal linkage between imports and economic growth variables; we provide new facts for the literature.

We utilize the GC test of Breitung and Candelon (2006) in the “spectral or frequency domain” enables to identify the causal robustness between imports and economic growth variables in different time duration in the model of bi-dimensional VAR model. Lemmens et al. (2008), believe that it is remarkable to carryout GC test in frequency domain, thus it possibly generate novel supplementary intuitions on causality compared with traditional Granger causality test. The facts supporting the above hypothesis have been recorded in an empirical revision. In addition to several studies, the highlighting methodological approach examined in studies is to apply the Granger anchorage test. We show empirical studies in Table 1.

### 3. Methodology and data collection

Our study is on the bases of annual data for the time of 1978–2019, preferred on the basis of the availability of fully data covering economic growth and imports of China, India and G7 countries. The data is collected from the World Bank website and we use imports (imports of goods and services (current US dollar), and economic growth (gdp per capita (constant 2010 US dollar)) accordingly. We convert the data through natural logarithm to obtain superior distribution characteristics (Ciner 2011).

### 4. Empirical test approaches

In frequency domain, we practice Breitung and Candelon (BC) Granger causality test, which show the causal prototype about two factors at distinct frequency domains by applying linear restrictions through auto-regression framework in the two-dimensional vector auto-regression model (VAR) (Granger, 1969; Geweke, 1982; Hosoya, 1991; Breitung and Candelon 2006; Ciner, 2011). First, we suppose $Y_t = (EG_t, IMP_t)$ be a bi-directional matrix of time series length $t = 1, ..., T$. In the following section, $EG_t$ and $IMP_t$ interpretation for economic growth and imports correspondingly. We supposed that $Y_t$ has a finite order (Eq. 1) vector auto-regression (VAR) process Breitung and Candelon (2006).

$$\Theta(L) Y_t = \epsilon_t $$

(1)

Where $\Theta(t) = I - \Theta_1 L - ..... - \Theta_d L^d$ is a $2 \times 2$ lag polynomial with the back-shift operator $L^j Y_t = Y_{t-j}$. The vector error $\epsilon_t$, is white-noise with 0 mean, and $E(\epsilon(\cdot) \cdot) = \Sigma$, where $\Sigma$ is positive definite covariance matrix.

Implementing Cholesky decomposition, $GG' = \Sigma - I$ (where G be the lower three dimensional matrix) such that $E (\eta_i \eta_j') = I$ and $\eta_i = G \epsilon_i$. In case of stationary system, the MA, demonstration of the system is as Eq. (2):

$$Y_t = \phi(L) \epsilon_t = \begin{bmatrix} \phi_{11} (L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{bmatrix} \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix} = \psi(L) \eta_t = \begin{bmatrix} \psi_{11}(L) & \psi_{12}(L) \\ \psi_{21}(L) & \psi_{22}(L) \end{bmatrix} \begin{bmatrix} \eta_{1t} \\ \eta_{2t} \end{bmatrix} \quad (2)$$

Where $\phi(L) = \Theta(L)^{-1}$ and $\psi(L) = \phi(L) G^{-1}$. Applying this illustration, the spectral density of $EG_t$ as Eq. (3):

$$f_{ac}(\sigma) = \frac{1}{2\pi} \left( |\psi_{11}(e^{-i\sigma})|^2 + |\psi_{12}(e^{-i\sigma})|^2 \right) \quad (3)$$

The evaluation of CM recommended by Geweke (1982) and Hosoya (1991) is classified as (Eqs. (4) and (5)):

$$CM_{G_1 \rightarrow IMP}(\tilde{\omega}) = \log \left( \frac{2\tilde{\omega} \phi_{11}(\tilde{\omega})}{|\psi_{11}(e^{-i\tilde{\omega}})|^2} \right) \quad (4)$$

$$= \log \left( 1 + \frac{|\psi_{12}(e^{-i\tilde{\omega}})|^2}{|\psi_{11}(e^{-i\tilde{\omega}})|^2} \right) \quad (5)$$

The computation is zero if $|\psi_{12}(e^{-i\tilde{\omega}})|^2 = 0$, wherein situation we state that $EG_t$ fails to cause $IMP_t$ at frequency $\tilde{\omega}$. In this frequency domain the calculation of causal relationship is possibly classified by applying the orthogonalized MA depiction Eq. (6):

$$\tilde{\omega} Y_t = \tilde{\phi}(L) \epsilon_t = \tilde{\psi}(L) \eta_t \quad (6)$$

where $\tilde{\phi}(L) = \tilde{\phi}(L) G^{-1}, \eta_t = G \epsilon_t$, and (where G be the lower three dimensional matrix), such that $E (\eta_i \eta_j') = I$. Point out that in a bi-dimensional co-integrated system, $\tilde{\beta} \tilde{\psi}(1) = 0$ where $\beta$ is a co-integration matrix so that $\beta$, $\tilde{y}_t$ is stationary. In this sense the stationary cause the following CM is Eq. (7):

$$CM_{\tilde{G}_1 \rightarrow \tilde{IMP}}(\tilde{\omega}) = \log \left( 1 + \frac{|\tilde{\psi}_{12}(e^{-i\tilde{\omega}})|^2}{|\tilde{\psi}_{11}(e^{-i\tilde{\omega}})|^2} \right) \quad (7)$$

However, according to Yao and Hosoya (2000), in this hypothesis, $EG_t$ fails to cause $IMP_t$ at frequency $\tilde{\omega}$ we contemplate the null hypothesis among a bi-dimensional framework. Hosoya (2001), propose to assess $CM_{EG_t \rightarrow \tilde{IMP}}(\tilde{\omega})$ (Eq. 8) by alternating $|\tilde{\psi}_{11}(e^{-i\tilde{\omega}})|$ and $|\tilde{\psi}_{12}(e^{-i\tilde{\omega}})|$ in Eq. (5) with assessments achieved from the fitted VAR.

$$CM_{\tilde{G}_1 \rightarrow \tilde{IMP}}(\tilde{\omega}) = 0 \quad (8)$$
Table 1. List of empirical studies and supporting hypothesis.

| Study | Time period | Countries | Methodology | Evidence/Hypothesis |
|-------|-------------|-----------|-------------|---------------------|
| Olufemi Adeyeye Aluko & Patrick Olufemi Adeyeye (2020) | 1985–2017 | 41- countries from South African | Toda-Yamamoto (T-Y)GC test | ILG, GLI, FB, Neutrality |
| Fapetu, O., & Owoneye.S.D. (2017) | 1981–2014 | Federal Republic of Nigeria | Toda-Yamamoto (T-Y)GC test | ILG |
| Bakazi, S. (2017) | 1965–2015 | Arab Republic of Egypt | VECM GC test | ILG |
| Bakazi, S. & Krit, M. (2017) | 1960–2015 | Mauritania | VECM GC test | FB |
| El Alaoui, A. (2015) | 1980–2013 | Kingdom of Morocco | VECM GC test | FB |
| Andrews, A.P. (2015) | 1970–2011 | Republic of Liberia | Pairwise GC test | FB |
| Kumari, D., & Malhotra, N. (2014) | 1980–2012 | India and China | Toda-Yamamoto (T-Y)GC test | FB and Neutrality |
| Chang et al. (2014) | 1996–2011 | 9 provinces of South African | Bootstrap panel Granger causality test | GLI, FB, Neutrality |
| Hye et al. (2013) | 1960–2009 | 6 South Asian countries | Modified Granger causality test | FB |
| Rahman, M.M., and Shabbaz, M. (2013) | 1990–2010 | Pakistan | VECM GC test | FB |
| Hye, Q.M. (2012) | 1978–2009 | People’s Republic of China | ARDL modelling approach | FB |

Table 2. Results of time domain Granger causality test.

| Study | Time period | Time domain GC test | Real → Imp | Imp → Real | hypothesis |
|-------|-------------|---------------------|------------|------------|------------|
| China | 1978–2019 | 13.662 (0.001)* | 12.427 (0.002)* | FBH |
| India | 1978–2019 | 10.949 (0.012)** | 9.4436 (0.009)* | FBH |
| Canada | 1978–2019 | 6.7801 (0.034)** | 28.979 (0.866)** | FBH |
| France | 1978–2019 | 2.2703 (0.518) | 12.477 (0.006)* | GLIH |
| Germany | 1978–2019 | 5.6619 (0.059)** | 12.427 (0.002)* | FBH |
| Japan | 1978–2019 | 7.7803 (0.020)** | 8.3189 (0.016)** | FBH |
| Italy | 1978–2019 | .37306 (0.946)** | 28.327 (0.000)* | FBH |
| UK | 1978–2019 | 3.3523 (0.501) | 11.887 (0.018)** | GLIH |
| USA | 1978–2019 | 5.9901 (0.200)** | 9.7586 (0.045)* | FBH |

Note: - Number in parentheses is p-values. * , ** , *** denotes significant at 1%, 5% and 10% level respectively. Imp denotes (imports of goods and services (current US$), Real denotes (gdp per capita (constant 2010 US$).
economic growth in time domain, we now utilize the granger causal test in China, India and G7 countries. Our research results contribute in some extent to support the hypotheses such as (1). Imports-led growth (ILG) hypothesis (2). Growth-Leads Imports (GLI) hypothesis (3). Feedback (FB) hypothesis (4). Neutrality (NH) hypothesis, about the causal nexus between imports and economic growth at high level frequency and low level, conforms to the short-term and long-term BC test. In the frequency domain (high and low levels), our findings on the ILG hypothesis in 4 countries (China, India, Canada, Germany), are constant with the Maitra (2020), who examined significant results of India’s short and long term ILG hypothesis, indicating that imports have an important impact on economic growth. In the frequency domain (high and low level), we prove the ILG hypothesis in 4 countries (China, India, Canada, Germany), however, in the short and long term, there is no indication persistent with the GLI hypothesis and neutrality hypothesis compared to the research of Chang et al. (2014). Their research findings approve the unidirectional causality between growths to import in four of the nine provinces surveyed in South Africa. Aluko and Adeyeye (2020), also observed that there is uni-directional causality between short-term and long-term economic growth and imports in several of the 41 countries surveyed but in our research there is no indication persistent with the GLI hypothesis and there is no indication persistent with the GLI hypothesis and neutrality hypothesis. The FB hypothesis in high frequency level is validated in 4 countries (France, Italy, UK and USA) and in low frequency level is proved Japan only. We notice diverse causality robustness between imports and economic growth, only in the short and long run for Japan. From our research results, we can see that in all selected countries, there is a frequency domain (high and low) proof of the bi-directional causal relationship between imports and economic growth. The imports and economic growth in most economies seem to be long and short-term dependencies. 

Accordingly, this study shows that policy-makers of these big economies need to analyse the robustness of the shift in the import and economic growth cause and effect throughout the year when planning policy actions. For further study, analysts may expand the scope of analysis by investigating the causality linkage between the variables (imports and economic growth) in China, India and G7 countries and divide imports into different factors. 

Regarding the methodological perspective, variations in data achieve technique and methods, may affect the valuation of the variables. When utilizing the periodic data, it is essential to be sure that variation from one year to the following and selection of countries or region may be brought changes in the results. However, the selection of variables as a proxy (substitute) is a problematic exercise, and is still a problem. Moreover, the techniques using in this paper could modify after particular interval, suppose that periodic data in which structure breaks can be

### Table 3. Results of frequency domain granger causality test.

| Study | Time period | Frequency domain GC test | Permanent (ρ = 0.01) |
|-------|-------------|--------------------------|-----------------------|
|       |             |                          | Imp → Real | Real → Imp | hypothesis | Imp → Real | Real → Imp | hypothesis |
| China | 1978-2019  | 8.1405 (0.0171)**        | 2.9288 (0.2312) | ILGH 22.8667 (0.005)* | 2.6126 (0.2708) | ILGH |
| India | 1978-2019  | 8.6537 (0.0132)**        | 3.7107 (0.1564) | ILGH 8.6537 (0.0132)** | 3.5591 (0.1687) | ILGH |
| Canada| 1978-2019  | 7.5636 (0.0226)***       | 1.0835 (0.5817) | ILGH 5.8038 (0.0549)** | 1.5025 (0.4718) | ILGH |
| France| 1978-2019  | 11.9764 (0.0007)*        | 10.2830 (0.0058)* | FBH 12.1617 (0.0016)* | 16.3127 (0.0003)* | FBH |
| Germany| 1978-2019 | 6.7293 (0.0346)***       | 3.8788 (0.1438) | ILGH 17.9492 (0.0001)* | 2.3384 (0.3106) | ILGH |
| Japan  | 1978-2019  | 5.5818 (0.0614)**        | 5.3057 (0.0705)** | ILGH 5.2724 (0.0716)** | 1.2033 (0.5479) | ILGH |
| Italy  | 1978-2019  | 6.5014 (0.0387)**        | 13.4513 (0.0012)* | FBH 10.7623 (0.0046)* | 7.3814 (0.0250)** | FBH |
| UK     | 1978-2019  | 5.9146 (0.0520)**        | 5.4400 (0.0659)** | ILGH 7.0211 (0.0299)** | 17.6749 (0.0001)* | FBH |
| USA    | 1978-2019  | 4.6536 (0.0976)**        | 9.6856 (0.0079)* | FBH 14.6959 (0.0060)* | 11.6631 (0.0029)* | FBH |

Note: - Number in parentheses is p-values. *, **, *** denotes significant at 1%, 5% and 10% level respectively. Imp denotes (imports of goods and services (current US$), Real denotes (gdp per capita (constant 2010 US$)).
illustrated. It is critical to frequently revisit the model by comprising fresh data that could improve and modify the results.

**Declarations**

**Author contribution statement**

Usman Khalid: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Usman Bashir: Conceived and designed the experiments; Wrote the paper.

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**Data availability statement**

Data will be made available on request.

**Declaration of interest’s statement**

The authors declare no conflict of interest.

**Additional information**

No additional information is available for this paper.

**Appendix 1. Level of Integration**

| Country   | Beak in Intercept | Beak in trend | Beak in Intercept and trend (both) |
|-----------|-------------------|---------------|-----------------------------------|
|           | Imp             | Real          | Imp       | Real          | Imp       | Real         |
| China     | 0 | 1 | 0 | 1 | 0 | 1 |
| India     | 1 | 0 | 1 | 0 | 1 | 0 |
| Canada    | 0 | 1 | 0 | 1 | 0 | 1 |
| France    | 0 | 1 | 1 | 0 | 1 | 0 |
| Germany   | 0 | 1 | 1 | 0 | 1 | 0 |
| Japan     | 0 | 0 | 1 | 0 | 1 | 0 |
| Italy     | 0 | 1 | 1 | 0 | 1 | 0 |
| UK        | 1 | 0 | 1 | 1 | 0 | 1 |
| USA       | 0 | 1 | 1 | 0 | 1 | 1 |

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