What Can Drive Socioeconomic Development in MENA High Income and Upper-Middle-Income Countries? A Panel Causality Analysis

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Abstract

Purpose – This study investigates the short- and long-run causality linkages between the socioeconomic development measured by the GNI per capita PPP (purchasing power parity) and 4 groups of selected factors including information and communications technology (ICT), political, demographic, and macroeconomic indicators in a panel of 19 countries classified as High Income (HI) or Upper-Middle-Income (UMI) countries from MENA zone between 2008-2021.
Design/methodology/approach – For comparison analysis between groups, the research design is based on four different Granger non causality tests. The first is the pairwise (Granger, 1969) non causality test, the second is the (Dumitrescu and Hurlin, 2012) panel non-causality test, the third is the panel VAR Block Exogeneity Wald Tests, and the latest is the panel ARDL ECM-based Granger non causality tests.
Findings – The results suggest that each group of the considered factors is a predictor with effects differ depending on the type of factors or the income level of the country. Based on the descriptive analysis and more sophisticated econometric techniques, the difference is obvious between the 2 groups of countries in the short- and long-term. Indeed, in the short term, besides agriculture indicator, the GNI for each group is affected by at least one of the ICT indicators in addition to tourism for the first group and demographic and political factors for the second group. In the long-run, GNI is caused by demographic factors for HI countries (except for Kuwait and Libya) and economic factor (except for Oman), ICT factors for Iran, Kuwait, Oman, and Lebanon and all UMI countries except Jordan. In addition, the political (demographic) factors for Lebanon, Saudi Arabia, and Turkey (for all UMI countries except Syria), and the economic (political) factors for Jordan, Egypt, and Tunisia (Algeria and Morocco) contribute to the GNI prediction in the long-run.
Originality/value –. In light of the MENA socioeconomic development aspirations to achieve convergence on key factor targets, including ICT, political, demographic, and macroeconomic indicators, this research provides novel insights on socioeconomic development predictors and causality linkages.
Practical implications –. According to the empirical findings, this paper identifies the factors that impact the socioeconomic development around the MENA zone. The findings come in help for Governments and policymakers to adjust their policies and to design the most adequate policy according to the causality linkages between GNI and the selected factors.

Keyword: Socioeconomic Development; ICT indicators; political, demographic and economic factors; MENA zone; Panel H-D Granger non causality; Panel VAR and panel ARDL ECM models.
Jelclassification: C23, F43, O10, O11, O20
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1. Introduction

The socioeconomic development path of each nation or group of nations is shaped by a specific factors. Decoding the impact of socio-economic indicators becomes essential for effective policy formulation (Ahmed and Sallam, 2020). Although the concept of 'socioeconomic development' is widely applied in research and in practice, its meaning may not always be clear. The word 'development' implies progress or advance, and may be defined as the overall activity in a society aimed at improvements in that society (Stec, et al., 2014). Previous studies have proved the existence of significant disproportions in the development of countries and regions (Greenberg, 2017; De Francesco and Maggetti, 2018, Nuralina, et al. , 2023). These disproportions can be observed in economic, social, and other fields. Nowadays, the assessment of socio-economic development cannot be focused only on economic and social indices. This is due to the significant implementation of information and telecommunication technologies in social life (Parra et al., 2021; Nuralina, et al. , 2023) as well as to the political condition effects (Cebula and Ekstrom, 2009).

Economic development refers to the growth in terms of economy, while social development refers to the entire well-being of the people in terms of education, health, etc. Socio-economic development is known as the programs, policies or activities that seek to improve the economic well-being and quality of life for a community. It incorporates public concerns in developing social policy and economic initiatives. It is measured with indicators, such as gross domestic product (GDP), life expectancy, literacy and levels of employment. Its purpose is to maintain the social and material well-being of the nation and its people with the aim of achieving the highest possible level of human development.

There are some internal and external forces which can have both positive and negative effects on socioeconomic development, which includes technological factors, political factors, demographic factors, and economic factors.

In the context of global changes, including political, economic, information and communications technology (ICT), and demographic upheavals, this research paper investigates the causal relationship between some socio-economic indicators and the socio-economic development in the context of 19 countries from MENA zone. Analysis will have interdisciplinary character as it relates sociological, technological, political, and economic dimensions of the analysis of development.

This study will focus on the impact of a variety of factors on the socioeconomic development via national income level (GNI) rather than on their domestic economic output (as measured by GDP per capita) to uncover the causality from politics, technology, demography and economic context on the overall development standing of the panel of 19 countries and of each country from MENA zone.[1]

[1] GNI per capita is considered a good proxy for the social and economic wellbeing of a country, as it provides a more complete picture of a country's total economic income, regardless of its source. Compared to GDP per capita measuring the value of domestic production and output, GNI per capita PPP is the value of domestic and foreign production taking into account the purchasing power parity as a measure of socioeconomic development.

In our paper, we offer an empirical analysis of a special type of 4 categories of factors in order to investigate the causality link between 14 different indicators and the socioeconomic development of 19 countries in the MENA zone. For that purpose, we stratify these countries into 3 economic levels according to the World Bank classification (developed or high income, upper middle income, and low middle income).

In this study, the researchers aims to identify the underlying determinants of economic growth in the Middle East and North Africa (MENA) region during the period 2008-2021 to identify the potential factors that could help explaining the difference in income levels observed across countries.

Using panel data, this article investigates the causality linkages between socioeconomic development and the 4 groups of selected factors (including information and communications technology (ICT), political, demographic, and macroeconomic indicators) by employing an econometric strategy involving in first step the application of 2 tests statistics: the pairwise (Granger, 1969) non causality test and the (Dumitrescu and Hurlin, 2012) (D-H) panel non-causality test, and then the application of the Granger non causality within two type of models: the Block Exogeneity Wald Tests based on the panel VAR models, and the Granger causality test based on the adjustment coefficient from the ECM framework of the panel ARDL models (with homogeneous or heterogeneous slopes).

Noting however that the limitation of some previous studies except (Amrouche & Hababou, 2022) is that it focuses on GDP instead of GNI, which as discussed earlier does not fully capture the economic income of a country. In this paper, on the other hand, a much broader concept the socioeconomic development was investigated.

In light of the existing literature on economic growth, the question this study made is an attempt to tackle is "which factor, be it economic, political, demographic and/or ICT, could help to detect the causality linkages with economic performance of the selected set of countries falling under the HI and UMI countries from Middle East and North Africa (MENA) region over the 2008 - 2021 period?".

With a focus on the MENA zone, this paper contributes to the literature on the determinants of socioeconomic development. The novelty of this paper is to identify the causality channels among the 4 groups of selected factors and socioeconomic development by income level for 14 years from 2008 to 2021.

The results suggest that each group of the considered factors is a predictor for the economic growth at the global level and that the effects differ depending on the type of factor or the income level of the country.

This paper is structured follow. After the introduction given in section 1, section 2 gives a selective literature review on the linkages between output (or output growth) and different factors including information and communications technology, political, demographic, and macroeconomic indicators. Section 3 presents variables and methodology of the research in 4 sub-sections. In the first sub-section, we analyze the data. In the second, we present theoretical development. In the third sub-section, we give the econometric strategy and different inference methods. Sub-section 4 sum up and discuss founding. Section 4 conclude the paper.

2. Literature review

The way of understanding the development concept in economics has been changing since the beginning of the discipline: from economic growth, through economic development to socioeconomic development (Litwinski, 2017). There are many concepts popular in economic discourse that are important for understanding the development. In the process of defining of development by economists, there could be indicated the following main steps in different epochs:

- economic growth (increase of volume of goods and services that are produced, in real terms; quantitative changes); [2]
- economic development (both quantitative and qualitative changes, e.g. transformation of production structure, implementation of new methods of management of resources);
- social development (qualitative changes of social structure as the social integrity and social trust (Fritz, 2004));
- socio-economic development (as adopted in (Chojnicki, 2010; UNDP, 2012; Bellu, 2011), it is a process of quantitative, qualitative and structural changes that are a result of actions of subjects taken within social and economic practice).[3]

Two topics are covered about the socio-economic development in the literature:

i) the first one concern the measure of the socio-economic development, and
ii) the second is about the determinants of socio-economic development.

This study will focus on the second subject. It poses the questions of whether

- the diffusion of information and communications technology (ICT) in countries,
- the political factors,
- the demographic factors, and
- the economic factors,

can affect socioeconomic development. Then, in this paper, 4 hypotheses will be investigated.

To answer these questions, we commence by reviewing, up to our best knowledge, every study that had the same motivation to explain the evolution exhibited by socioeconomic development; be it in a cross–country or in country–specific framework.

The first hypothesis is about technological factors (mobile-cellular telephone subscriptions, individuals using the internet, network readiness index for information and communication technology usage in the country).
In the 21st century, the information and communication technology (ICT) became one of the chief driving forces for economic growth. All economic activities are touched by internet and

[2] "[…] Division of economic development and economic growth took place in 1960s. Change of understanding of development concept was caused by the following factors: (1) influence of new sociological and philosophical ideas, (2) historical events (mainly the Second World War and decolonisation process), (3) growing meaning of formalism and scientism in economic considerations, (4) appearance of mechanistic ideas in economics, (5) international cooperation for development that allows to formulate preferred development goals" (Litwiński, 2017b).

[3] Socioeconomic development is the progressive reinforcement of a socioeconomic organization's quantitative and qualitative dimensions towards a higher level of efficiency, well-being, justice, and democracy at all levels.

mobile phone connectivity. It changed the way we think, learn, and work. This widespread adoption and use of digital technologies such as computers, the internet, mobile devices, and software applications has had a profound impact on the production processes. This tendency attracts researchers to focus their attention on the impact of ICTs in the human activities over the world and then on the economic growth.

Some researchers based their study on the relationship between Information and Communication Technologies (ICT) and economic growth such us (Ngwenyama, O., et al., 2006; Choi, C., Yi, M, 2009; Andoh-Baidoo, F. K., et al., 2014; Qureshi, S., & Najjar, L, 2015; Sağlam, B. B, 2016; Salahuddin, M., Gow, J , 2016; Niebel, T, 2018: Maurseth, P.B, 2018; and Haftu, G.G, 2019).
ICT diffusion causes economic growth in a unidirectional manner (Alimi, A.S. and Adediran, I.A., 2020; Pradhan, R.P., et al., 2018; Pradhan, R.P., et al., 2021 and Sawng, Y.W., et al., 2021). Additionally, (Chakraborty, C. and Nandi, B., 2011 and Ramlan, J. and Ahmed, E.M., 2009) indicated the presence of a bidirectional causal relationship among the variables.
Some studies showed that the variables have no causal association (Dutta, A. , 2001 and Veeramacheneni, B., et al. , 2007).
Many studies have investigated the impact of ICT diffusion on economic growth in developing countries. For instance, (Hassan, Mohammad. Kabir, 2005 and Sassi, Seifallah & Goaied, Mohamed , 2013) studied this phenomenon in the Middle East and North Africa (MENA) region. Similarly, research by (Andrianaivo, et al., 2011; Lee, Sang H., et al., 2012; Wamboye, et al., 2015 and Albiman, et al., 2016) explored these effects in the Sub-Saharan Africa (SSA) region.
The studies of (Hardy, Andrew P. , 1980; Roller, et al., 2001); Madden, Gary, and Scott J. Savage., 1998; Andrianaivo, Mihasonirina, and Kangni Kpodar., 2011; (Sassi, Seifallah & Goaied, Mohamed , 2013; Pradhan, et al., 2015; Verma, A. and Giri, A.K. , 2020; Chatterjee, A. , 2020; Dahmani, M., et al., 2021; Franciskovic, J.M. and Miralles, F. , 2021 and Salahuddin, M., Gow, J , 2016) found a significant positive relationship between ICTs and economic growth.
Similarly, specific national case studies highlight the beneficial effect of ICTs in stimulating long-term growth and development are (Kasahara H, Rodrigue J , 2008) for Indonesia, (Jalava J, Pohjola M, 2008) for Finland, (Kumar, et al., 2015) for China. In contrast, the study of (Aghion P, Howitt P , 1998) showed that ICT diffusion could affect economic growth in a negative way especially in developing countries.
Hence, the first hypothesis is formulated as follows:
H1.Technological factors have a positive impact on economic growth.

The second hypothesis is about political factor (peace).
There are a limited number of frameworks that have studied the effect of peace and economic growth and revealed that a peaceful environment affects growth positively (Huang, S., Throsby, D, 2011; Deyshappriya, N.P.R., 2015 and Bayar, Y., 2016). Similarly, the study of (Uddin, A., Masih, M. , 2016) investigated the interaction between political stability and economic growth of 16 Organisation of Islamic Cooperation countries over 1990–2011 period and showed that political stability positively affects economic growth.
Hence, the second hypothesis is formulated as follows:
H2.Political factor has a positive impact on economic growth.
The third hypothesis is about demographic factors (education, life expectancy, urban population and human development (HDI)).
There are some researchers studied the link between education and development such as (Bils, M. and Klenow, P. J., 2000; Hanushek E. A., 2016 and Agarwal, Pawan, 2006).

The studies of (Mills, et al., 1986 and Bertinelli, L., and Black, D., 2004) suggested that urbanization should have a positive impact on economic growth. In contrast, (Alam, et al., 2007) argued that rapid urbanization can negatively affect the economy via its effect on damaging infrastructures.
Other analysis such as (Shabu. Terwase , 2010) found that there is weak relationship between urban growth and economic development in developing countries.
(Castells-Quintana, David , 2011) considered that the consequence of the link between this variables is a complex phenomenon and depends on several factors such as level of development, stage of urbanization, and nature of main economic activities.
Many studies showed that health has a positive impact on the economic growth through the increase in worker productivity (Schultz, P.T. and Tansel, 1992), (Strauss, J. and D. Thomas , 1998), (Schultz, P.T., 1999a), (Schultz, P.T. , 1999b), (Savedoff, W.D. and P.T. Schultz , 2000)and (Schultz, P.T., 2002).Similarly, (Bloom, D. and J.D. Sachs, , 1998), (Gallup, J.L., J.D. Sachs and A.D. Mellinger, 1999), (Bloom, D., D. Canning and P. Malaney, 1999), (Lorentzen, P., J. Mcmillan and P. Wacziarg, 2008) indicated that an increase in life expectancy has a positive effect on economic growth. Contrary, (Acemoglu D., Johnson S., 2007) and (Acemoglu, D. and Johnson, S., 2014) cannot found a positive relationship between the improvement of life expectancy at birth and income growth.
(Acemoglu D., Johnson S., 2007) and (Hansen C. W. Lønstrup L., 2015) explained that an increase in the life expectancy reduced the real GDP per capita growth rate and fostered population growth. Similarly, (Barro, R.J. and J.W. Lee, 2010) confirmed a negative relationship between life expectancy and economic growth.
Several studies such as (Dreze, J., & Sen, A. , 2002); (Ranis, G., Stewart, F. J. J. o. H. D., & Capabilities, 2012); (Stiglitz, 2009), (Isola, Wakeel A. and Alani, R. A., 2012), (McGrath P., 2016) and (Cuaresma J. C., Doppelhofer G., Huber F., Piribauer P. , 2018) examined the impact of human development on economic growth.
The research of (Ranis, G., Stewart, F., & Ramirez, A. J. W. d. , 2000) identified a strong bidirectional relationship between human development and economic growth.
(George, Emmanuel O. and Ogunyomi, O. O., 2019) concluded that human capital has a positive relationship with economic growth in Nigeria and found bidirectional causality between these variables using income measurement approach.
Hence, the third hypothesis is as follows:
H3.Demographic factors have a positive impact on economic growth.
The forth hypothesis will be about economic factors (unemployment, tourism, trade, agricultural, labor force participation and gross capital formation).
Many studies (Moscarini, G., and Postei-Vinay, F., 2012), (Inderbitzin, L., Staubli, S. and Zweimüller, J. , 2016), (Agrawala, A., Matsab, D. , 2013), (Chetty, R. , 2008), (Chetty, R. , 2008), (Amaral, P. and Ice, J. , 2014), (Card, D., Chetty, R. and Weber, A., 2007), (Ziberi, B., & Avdiu, M. , 2020) and (Dewi Kurniawati , Fitra Rizal, 2022) investigated the relationship between unemployment and economic growth.
The studies of (Shahid, M. , 2014), (Hussain, T., Siddiqi, M. W., & Iqbal, A. , 2006)in Pakistan and (Jaradat, M. A. , 2013)in Jordan found the relationship between unemployment and economic growth to be negative. Contrary, the research elaborated by (Banda H., 2016) showed that the relationship between unemployment and economic in South Africa to be positive in the long-run.
The study of (Dayıoğlu, T., & Aydın, Y., 2020) found an inverse relationship between unemployment and growth rates in Turkey.
Specific country case studies emphasizing the effect of tourism in growth are (Durbarry, R. , 2004) for Mauritius, (Nowak, J.J., Sahli, M., Cortés-Jiménez, I. , 2007) for Spain, (Kumar,

R.R., 2014b) for Kenya, (Ishikawa, N., Fukushige, M. , 2007) for Japan, (Katircioglu, S.T., 2009) for Turkish and (Dritsakis, N. , 2004) for Greece.
Some empirical studies tested concluded that international tourism promotes long-term economic growth (Balaguer, J., and Cantavella-Jorda, M. , 2002), (Cortez-Jimenez, I., and Paulina, M., 2006), (Lee, C.C., Chang, C.P. , 2008), (Narayan, P.K., Narayan, S., Prasad, A., Prasad, B.C., 2010), (Tang, C.F., and Tan, E.C. , 2015), (Stauvermann, P.J., Kumar, R.R., Shahzad, S.J.H., Kumar, N.N. , 2018).
(Durbarry, R. , 2004), (Seetanah, B. , 2011) and (Kim, H. J., Chen, M.H. , 2006) identified a bidirectional causality between tourism and economic growth.
(Brida, J. G., Barquet, A., & Risso, W. A. , 2009) showed the initially negative impact of tourism on economic growth and its later positive impact in the long-term, (Jin, J. C. , 2011) showed an initially positive impact and a negative effect in the long-term.
Some studies such as (Chang, R., Kaltani, L., Loayza, N.V., 2009); (Kim, D.-H., 2011); (Jouini, J., 2015) have identified a positive association between trade openness and economic growth, while others researchers (Musila, J.W., Yiheyis, Z., 2015); (Ulaşan, B., 2015) have found no association, or even a negative association.
The analysis of (Kim, D.-H., Lin, S.-C., 2009) found significant threshold effects in the relationship between trade and growth. Greater openness to international trade has positive impacts on economic growth for high-income economies. However, for low-income economies, higher trade openness has negative impacts on economic growth.
Based on the study of (Herzer, D., 2013), the impact of trade openness is positive for developed countries and negative for developing ones.
The study of (Awokuse, O. T., 2009) analyzed the dynamic interaction between agriculture productivity and economic growth. (Awan, A.G. & Vashma Anum, 2014) showed the existence statistically significant and positive relationship between agriculture growth and GDP growth. (Awan, A.G. , 2014) indicated that due to low agriculture productivity in the emerging economies and the income gap between emerging and advanced countries have negative effects on the economic growth in the selected emerging economies.
Hence, the fourth hypothesis to be tested is as follows:
H4.Economic factors have a positive impact on economic growth**.**
Table 1 provides a summary of notable studies on different factors and economic growth.

The research questions are important as they could help many countries suffering from low socioeconomic standing to implement effective solutions. To the posed questions, we'll examine if the impact of the 4 groups of selected factors (including information and communications technology (ICT), political, demographic, and macroeconomic indicators) on socioeconomic development may differ depending on the income level of the considered economies. And, contrary to previous studies, our paper includes different types of factors, proposes various dynamic models, and check the short- and long-run causality linkage in order to enhance our understanding of the transformative process on socioeconomic development using a MENA zone dataset.

3. Data, descriptive analysis, and model specification

3.1 Data Analysis

In this paper, the dependent variable GNI is defined by the (OECD, 2020) as "gross domestic product, plus net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production" will be used as a measure of the socioeconomic development.

15 variables (including the dependent variable: GNI which is considered as proxy for the social and economic wellbeing of any country) are used in this paper. All of the 14 considered independent variables are classified in 4 categories. We present the following independent variables by class:

i) Set of the technological factors or information and communication technology (ICT) factors represents the information technology variables proxied by three variables [including Mobile-cellular telephone subscriptions (Mobil1), Individuals using the Internet (UI), and Network Readiness index (NetRead)],

ii) Set of the political factor [including global peace index (GPI)], since peace and stability are considered us prerequisites for the socio-economic development,

iii) Set of the demographic factors to indicate the role of the human capital quality for population of each country for the economic growth [including Education Index (Educ), Life Expectancy (LifeExp), % of Urban population (Urban), and humain development index (HDI)], and

iv) Set of the economic factors [including Unemployment rate (Unemp), Percent of tourism per capita (Tourism), Trade, the agricultural added value (VAA), Gross capital formation (K), and Labor force participation (L)].

Data were sourced majorly from World Bank Development indicators (WDI).[4] Sources and definitions in details of all variables are available in Table A1 (see Annex). Annual collected data was informed partly by data availability for $N = 19$ MENA countries, as presented at Table A3 in the Annex, over 2008 - 2021 period ($TN = 266$ observations for each variable).

To conduct a comparison analysis by income level, we use the classification proposed by the World bank (WB) as given in Table A2 (see Annex). Using this classification, we get the first group of 10 countries with high income (HI), a second group of 8 countries with upper middle income (UMI), and only one country (Yemen) with Low middle income. Yemen is then dropped from the subsequent investigations.

Before examining if there is any causality relationship or cointegrating among dependent and independent variables, we use the ADF Fisher $\chi^2$and PP Fisher χ^2 and Im, Pesaran and Shin W-stat (IPS) unit root tests to check the order of integration of each variable. Results in details are available upon request. The sum up given in Table 1 by group concludes that there exists some variables with no unit root (with one unit root) and hence confirming their stationarity (confirming their integration at order one). Then, only four (three) out of the 15 considered variables which are stationary (nonstationary) for both groups.

Table 1: Sum up of unit root test results for both groups

Group	**LGNI**	**LL**	**LK**	**LVAA**	**URBAN**	**LMobile1**	**LLifeExp**	**HDI**
1	SL2	SL2	SL2	I(1)	SL2	SL2	SL2	SL2
2	SL2	I(1)	I(1)	I(1)	I(1)	SL2	I(1)	SL2
Group	**LNetRead**		**UI**	**LEduc**	**GPI**	LTourism	**Trade**	**Unemp**
1	I(1)		SL2	SL2	I(1)	SL2	I(1)	I(1)
2	SL2		I(1)	SL2	SL2	I(1)	I(1)	I(1)

[4] Specifically, data on agricultural output (VAA), Trade percentage of GDP, Unemployment (% of total labor force), Percent of tourism per capita, Urban population (% of total population), and GNI per capita PPP, Human Development Index were sourced from WDI. However, Individuals using the Internet and Mobile-cellular telephone subscriptions were sourced from itu.int, while Network Readiness index is from reports.weforum.org, Global peace index (GPI) and (Education Index and Life Expectancy) were sourced respectively from isionofhumanity.org and hdr.undp.org.

Note: LGNI, GNI per capita PPP in log; $LMobile1$, the Mobile-cellular telephone subscriptions in log; UI, the Individuals using the Internet (% of population); LnetRead, the Network Readiness index in log; GPI, the global peace index; LEduc, the Education Index in log; LLifeExp, the Life Expectancy in log; Urban, Urban population (% of total population); HDI, the Humain Development Index; Unemp, Unemployment rate; LTourism, the Percent of tourism per capita in log; Trade, the Trade (% of GDP); LVAA, the Agriculture added value in log. The above results concern the 2008–2021 period. SL2: stationary. I(1): integrated of order 1.
Source: Author's computation.

Some descriptive statistics (number of observation, average value, median, max, min, and standard deviation) by groups for all variables are employed in our statistic and econometric analysis. As it is evident, the statistics between the two groups of level of GNI display quite different patterns, with HI countries showing lower Mobile1, NetRead, LifeExp, Unemp, and VAA, but higher LGNI, Educ, and HDI than UMI countries. For space limitation, these results are not reported here but are available upon request. More rigorous results can be get by statistical inferences. The covariance analysis (ANOVA) test is applied on the considered variables. Significant difference between groups is detected in 14 out of the 15 variables. Difference between group behaviors is stressed by the dependent variable GNI, and all the independent variables except capital LK (details about these results are available upon request).

In effort to forestall multi-collinearity in linear model estimation, correlation analysis was conducted by group of countries to determine variables which can be considered as a recipe for multi-collinearity. Subsequently, we test the correlations among variables (stationary variables in level, and I(1) variables in first difference) to confirm that the operational regression models are free from the multi-collinearity problem (matrices are available upon request).

From the correlation matrix for the first group of HI countries (second group of UMI countries), GNI in log LGNI is found to be significantly correlated with Lmobile1, UI, and HDI (with UI, HDI, LEduc, LifeExp, and Trade). Since these independent variables are correlated, three (five) linear static regressions augmented by the remaining non-correlated control variables can be proposed for GNI evolution analysis in the group1 (group 2) case of considered countries. Note of Table A5 (in Annex) gives more details about these proposed linear static models.

3.2 Theoretical Development

This study proposes a framework in which the dependent variable GNI in log (LGNI) is determined through the interaction evolution of the independent variables (including the ICT factors, political factor, demographic factor and economic factors). Since the considered variables are mixed (I(0) or I(1)), we can either consider panel ARDL model which is the appropriate model for mixed variables case or a panel VAR (by taking in first difference each of the I(1) processes).

Following similar study in this area, LGNI can be expressed as a linear static or dynamic function. This framework builds on several earlier frameworks but it is more general and for the purpose of estimation within the ARDL panel data, the baseline model takes the following form:

$$LGNI_{it} = c_i + \lambda_i t + \sum_j \alpha_j Zj_{it} + \varepsilon_{it} \quad (1)$$

where $Zj_{it} = logXj_{it}$ or Xj_{it}, Xj_{it} is one of the 14 independent variables for country i in time t..

To avoid multi-colinearity problem, only non-correlated independent variables will be present in Eq (1). Then, according to Pesaran et al. (1999, 2001), the homogenous slope panel ARDL is expressed as follows (Kallal, et al., 2021):

$$\Delta log\ Y_{it} = \alpha_i + \rho log\ Y_{it-1} + \sum_j \alpha_j Zj_{it-1} + \sum_{k=1} \rho_k \Delta log\ Y_{it-k}\ + \sum_{k=0} \sum_j \alpha_{jk} \Delta Zj_{it-k} + \varepsilon_{it} \quad (2)$$

or in the following error correction model (ECM):[5]

$$\Delta log\ Y_{it} = \alpha_i + \varphi ECT_{it-1} + \sum_{k=1} \rho_k \Delta log\ Y_{it-k}\ + \sum_{k=0} \sum_j \alpha_{jk} \Delta Zj_{it-k} + \varepsilon_{it} \quad (3)$$

in which Granger causality test can be done, where

$$ECT_{it-1} = log\ Y_{it-1} - [\sum_j \delta_j lZj_{it-1}]$$

is the error correction term representing the long-run relationship and φ captures the sensitivity of the error correction term, ρ_k and α_{jk} represent short-run parameters, δ_j, represent long-run parameters, Δ is the first difference operator. Again, caring about multi-collinearity problem, only non-correlated independent variables will be present in Eq(2).

For the Granger causality test application, both panel ARDL model and panel VAR model can be useful. In the VAR model, block exogeneity Wald tests will be used for the short-run case, while in the ARDL framework, the Granger causality test verification is done via the significance of the adjustment coefficient φ in the ECM specification for the long-run case. A *negative* and significant φ in Eq (3) indicates that there is a *long-run causal relationship.* Precisely, there are *unidirectional causality* from considered independent variables to the socioeconomic development.

3.3 Econometric Strategy

The suggestions from the previous studies drive modern econometric techniques to test the short-run dynamic and long-run impact of the concern variables on socioeconomic development. This section will be based on the following econometric steps:

(1) The use of the pairwise short-run (Granger, 1969) non causality test,

(2) Application of the Cross-sectional dependence (CD) tests as (Pesaran, 2020)' test (on regression residuals) and short-run (Dumitrescu and Hurlin, 2012) (D-H) panel non-causality test,

(3) Estimation of the panel VAR model and the short-run Granger non causality/Block Exogeneity Wald Tests,

(4) Slope homogeneity tests (Swamy, 1970 and BW., 2013) application and the panel ARDL model estimation and the practice of the long-run non causality test based on the adjustment coefficient φ from the ECM framework.

1) The pairwise Short-run (Granger, 1969) non causality test

Following (Tekin, 2012), our focus will first be on the pairwise, one-period-ahead causal relationships between the dependent variable LGNI and the 14 independent variables in short-run. Pairwise (Granger, 1969) causality test results are presented at Table 2. It is clear that LGNI can be predicted differently from considered groups. For group 1, the political factor GPI is found to cause à la Granger socioeconomic development. However, finding say in addition that for group 1 of the HI countries, there are two economic factors VAA and Tourism which cause

[5]In the heterogeneous slope version,

$$ECT_{it-1} = log\ Y_{it-1} - [\sum_j \delta_{ji} logXj_{it-1}].$$

à la granger LGNI, while for group 2 of UMI countries, three demographic factors: LifeExp, Educ and HDI, and only one economic factor: VAA which are pertinent predictors for LGNI.

Table 2: Pairwise short-run Granger non causality test results

		Group 1 (10 HI countries)			
Factors	**Null Hyp**	**Obs**	**F-Statistic**	**p-value**	**Causality ?**
Politic	GPI ↛ LGNI	120	14.4869	0.0002	GPI → LGNI
Economic	LVAA ↛ LGNI	117	3.14711	0.0787	LVAA → LGNI
	LTourism ↛ LGNI	89	3.9731	0.0491	LTourism → LGNI
		Group 2 (8 UMI countries)			
Factors	**Null Hyp**	**Obs**	**F-Statistic**	**p-value**	**Causality ?**
Demographic	Educ ↛ LGNI	104	11.5433	0.0010	Educ → LGNI
	LLifeExp ↛ LGNI	96	12.6534	0.0006	LLifeExp → LGNI
	HDI ↛ LGNI	104	11.2717	0.0011	HDI → LGNI
Economic	LVAA ↛ LGNI	95	5.89502	0.0171	LVAA → LGNI

Note: For space limitation, only significant results are presented. → homogeneously cause (↛): (does not). In testing for Granger causality for two stationary variables Y_{it} and X_{it} , we consider the following model Y_{it} = a + $\sum_{j=1}^{p} C_j Y_{it-j}$ + $\sum_{j=1}^{p} D_j X_{it-j}$+ ε_{it}. X does not Granger cause Y if D_j = 0 for all $j = 1, \dots, p$. I(1) variables are taken in first difference since this procedure is applied only on SL2 process. Source: Author's computation by Eviews 13.

2) CD tests and the short-run (D-H, 2012) panel non-causality test

Cross-sectional dependence (CD) can exist due to the unobserved common factors, economic and regional linkage, latent heterogeneity, and the presence of externalities. (Wang and Dong, 2019) advocated that in the presence of CD, the appropriate causality test is the (Dumitrescu and Hurlin, 2012) (hereafter D-H) panel non-causality test which is individual Wald statistic based on the cross-section average unit of (Granger, 1969) non-causality test.[6] Table 3 expresses the results of some CD tests among countries, which indicate the eventual absence by 3 out of the 5 considered tests (by 2 out of the 5 considered tests) of CD in the first group of the HI countries (in the second group of the UMI countries).

Table 3: Results of cross-sectional dependence (CD) tests

	Group 1 (10 HI countries)			Group 2 (8 UMI countries)		
Test	**Statistic**	**d.f.**	**p-value**	**Statistic**	**d.f.**	**p-value**
Breusch-Pagan LM	47.6197*	21	0.000774	26.3432*	21	0.034566
Pesaran scaled LM	4.107509*		3.999e-05	2.070976*		0.038361
Pesaran CD	2.64337*		0.0082083	-0.91098		0.362301
Frees (1995)	0.160			0.720*		
Pesaran (2020)	1.388		0.1653	-0.675		0.4995

Note: CD test is based on the CD in the data or on the regression residuals from LGNI on the 14 independent variables. Null hypothesis of CD test: No cross-section dependence (correlation) in residuals of the FE regression. (Breusch & Pagan, 1980) LM test statistics is $CD_{LM} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \sim \chi^2_{n(n-1)/2}$, where $\hat{\rho}_{ij}$ is the sample approximate of pair-wise residual

[6] Different considered CD tests in this paper are explained in the note of Table 3.

correlation. LM test is valid for T→∞ with N fixed and is inappropriate if N is large. If T→∞ and N →∞, the scaled version (Breusch & Pagan, 1980) LM test statistics is $CD_{SLM} = \sqrt{\frac{T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2}$. Alternatively, (Pesaran, 2004) proposed the $CD_P = \sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}$ $\sim N(0,1)$ under the null hypothesis of no cross-sectional dependence. Critical values from (Frees, 1995)' Q distribution at α = 0.05 for the first (second) group is 0.4325 (0.6860).
Source: Author's computation by Eviews 13 and STATA 15.

Results from D-H panel non Causality test are presented at Table 4. Looking at Table 4, it is clear that LGNI cannot be predicted in the short-run from considered variables for the second group. In the first group, 3 out of the 14 variables are found to cause à la Granger (D-H) socioeconomic development in the short-run. For the HI countries, LGNI is found to be Granger caused by two technological factors UI and LMobil1 and one economic factor: the capital (LK).

Table 4: Results of the D-H panel short-run non Causality Tests

	Group 1 (10 HI countries)				
Factors	**Null Hypothesis:**	**W-Stat.**	**Zbar-Stat.**	**p-value**	**Causality ?**
ICT	LMobile1 ↛ LGNI	3.38733	3.09672	0.0020	LMobile1→LGNI
	UI ↛ LGNI	2.37728	1.64650	0.0997	UI → LGNI
	LNetRead ↛ LGNI				++
Economic	LTourism↛ LGNI				++
	LK↛ LGNI	3.17109	2.57349	0.0100	LK→ LGNI
	Group 2 (8 UMI countries)				
	NetRead ↛ LGNI				++
	LTourism↛ LGNI				++
	LK↛ LGNI				++

Note: For space limitation, only significant results are presented. I(1) variables are taken in first difference. → (↛): (does not) homogeneously cause. ++ : no results because of insufficient observation number or near singular matrix for some cross section. Author's computation by Eviews 13. The panel D-H causality test is done in the following Equation: $Y_{it} = \alpha_i + \sum_{j=1}^{p} C_{ij} Y_{it-j} + \sum_{j=1}^{p} \boldsymbol{D}_{ij} X_{it-j} + \varepsilon_{it}$. Dumitrescu and Hurlin (2012) test statistic is the average of individual Wald statistic $W_{i,T}$ based on the cross-section unit of non-causality Granger (1969).defined as follow: $W_{N,T}^{D,H} = N^{-1}\sum_{i=1}^{N} W_{i,T}$.

3) VAR model and the Short-run Granger non Causality/Block Exogeneity Wald Test

The dynamic feature of the panel autoregressive distributed lag model allows to use the impulse response functions (IRF) to capture the dynamic relationships and to use the panel error correction-based Granger causality tests among considered variables. In the following, we adopt a panel stationary VAR model as in (Holtz-Eakin, et al., 1988; Sağlam, 2016; and Neifar, 2022c) to examine the possible linkages among ICTs factors, political factors, demographic factors and socioeconomic development as well as others economic factors. The considered dynamic panel autoregressive distributed lag model is specified as in the following framework:

$$Y = A(L)\,Y + \varepsilon, \qquad (4)$$

where,[7]

$$Y = (LGNI, LMobile1, UI, \Delta GPI, LEduc, LLifeExp, Urban, HDI, \Delta LNetRead, \Delta Unemp, \Delta Trade, \Delta LVAA, LL, LK, LTourism)',$$

for the first group, and

$$Y = (LGNI, LMobile1, \Delta UI, GPI, LEduc, \Delta LLifeExp, \Delta Urban, HDI, LNetRead, \Delta Unemp, \Delta Trade, \Delta LVAA, \Delta LL, \Delta LK, \Delta LTourism)',$$

for the second group,

$A(L)$ is a 15 ×15 matrix of the p[th] order polynomials of the lag operator (L) with p ≥ 1,

ε are disturbances that are assumed to be independently and identically distributed.

The panel VAR model (4) is estimated with the optimal lag for each group (VAR(2) for group 1 of the HI countries and VAR(1) for group 2 of the UMI countries). Details of the estimation results and the corresponding impulse response function (IRF) are not reported here, but are available upon request. Only significant *Block Exogeneity Wald Granger non causality test* results which are presented and the corresponding IRF. Looking at Table 5, results reveal that for both group, all of the considered independent variables are found to globally Granger cause socioeconomic development in short-run. Specifically, these results are significantly driven in short-run by one common and some different factors. In short-run, for both groups, LGNI is affected by LTourism (*economic* factor). In addition, for the HI countries, LGNI is Granger caused by two *ICT* factors UI and LNetRead. Differently, in the second group of the UMI countries, LGNI is Granger caused by Trade (*economic* factor), by one *ICT* factor: LMobile1, by one *political* factor: GPI, and by three demographic factors LEduc, Urban and HDI.

Looking at the IRF representation (available upon request) for the HI countries (group 1), it showed that each of the 14 independent variables has some effect on LGNI in both short- and long-run with either low positive or low negative effect. Some variables did not affect LGNI in the beginning, but the function took off and fluctuated from its equilibrium position after some time. For the HI countries, Figure 1 reproduce the response of LGNI for only significant effects (UI, LNetRead, and LTourisme). UI (LNetRead, and LTourism) had short- and long-run positive (an initial positive followed by negative) impact on LGNI. UI had a positive effect on socioeconomic development in the long-run with a slight increasing effect. As the Tourisme variable, LNetRead presents a long-run negative effect on LGNI with an increasing effect.

The first group of HI countries experienced a positive short- and long-run socioeconomic development improvement (deterioration) due to UI (LNetRead and LTourism) and that it doesn't diminish with time. The final negative impact of LNetRead and LTourism on socioeconomic development suggest that Network Readiness and Tourism-investments might have been counter-productive at the end. The initial some positive responses period turned out to be worthless.

[7] LGNI: is the GNI per capita PPP in log, $LMobile1$: is the Mobile-cellular telephone subscriptions in log, UI: is the Individuals using the Internet (% of population), ΔGPI: is the global peace index in first difference, LEduc: is the Education Index in log, LLifeExp: is the Life Expectancy in log, Urban is the Urban population (% of total population), HDI: is the Human Development Index, ΔUnemp: is the Unemployment rate in first difference, ΔTrade: is the Trade (% of GDP) in first difference, ΔLVAA: is the growth of Agriculture added value, LL or ΔLL: is the labor in log (L) or in growth, LK (ΔLK): is the log of capital (capital growth). In the benchmark model, we use $p = 2$. Optimal lag is based on AIC.

Referring to the IRF for UMI countries (group 2) in Figure 2, it can be seen that there are three (two) factors with positive (negative) significant effects. The UMI countries experienced a positive short- and long-run socioeconomic development improvement (deterioration) due to Lmobile1, Leduc, and Trade (Urban and HDI). Nevertheless, GPI, and LTourism chocks had alternate effects. There was a low positive (negative) initial effect from GPI (LTourism) which is followed by a negative (positive) effect. The initial negative (positive) impact of LTourism (GPI) on socioeconomic development suggest that Tourism (peace) investments might have been counter (pro)-productive at the start. This initial period of negative (positive) responses turned out to be worthwhile (worthless).

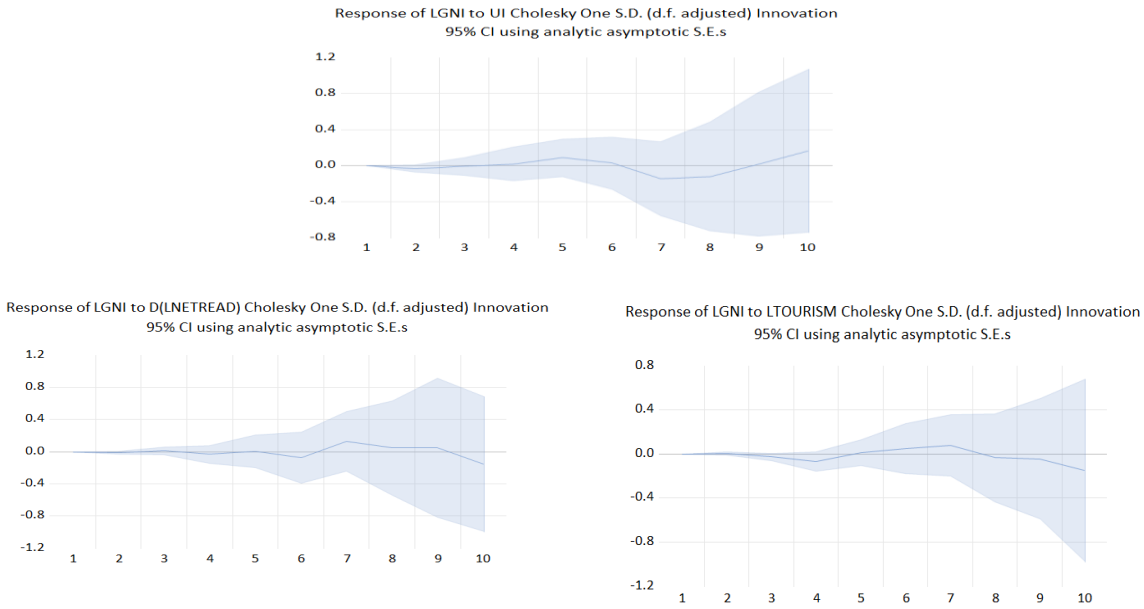

Figure 1: Impulse response function of GNI to UI, LNetRead, and LTourism chocks from VAR(2) model for HI countries.

Note: Only response to significant factors which are presented here. Author's computation by Eviews 13.

Table 5: VAR Short-run Granger Causality/Block Exogeneity Wald Tests results

		Group 1 (10 HI countries)			Group 2 (8 UMI countries)		
Factors	**No Null hypothesis**	**$\chi 2$**	**p-value**	**Causality ?**	**$\chi 2$**	**p-value**	**Causality ?**
ICT	UI↛LGNI	13.11654	0.001418	UI→LGNI			
	LNetRead↛LGNI	14.43839	0.000732	LNetRead→LGNI			
	LMobile↛LGNI				3.22489	0.0725263	LMobile→LGNI
Economic	LTourism↛LGNI	8.154356	0.016955	LTourism→LGNI	3.20788	0.0732839	LTourism →LGNI
	Trade↛LGNI				3.186308	0.0742575	Trade→LGNI
Politic	GPI↛LGNI				6.801977	0.00910569	GPI→LGNI
Demographic	LEduc↛LGNI				15.79244	7.06843e-05	LEduc→LGNI
	Urban↛LGNI				7.151927	0.0074883	Urban→LGNI
	HDI↛LGNI				19.407665	1.0558e-05	HDI→LGNI
	All↛LGNI	122.9385	7.30155e-14	All→LGNI	61.54096	6.2857e-08	All→LGNI

Note: For space limitation, only significant results are presented. Optimal panel VAR(2) (VAR(1)) model is used for test application for the first (second) group. → (↛): (does not) homogeneously cause. I(1) variables are taken in first differences since the VAR model is adequate only for SL2 processes. Author's computation by Eviews 13.

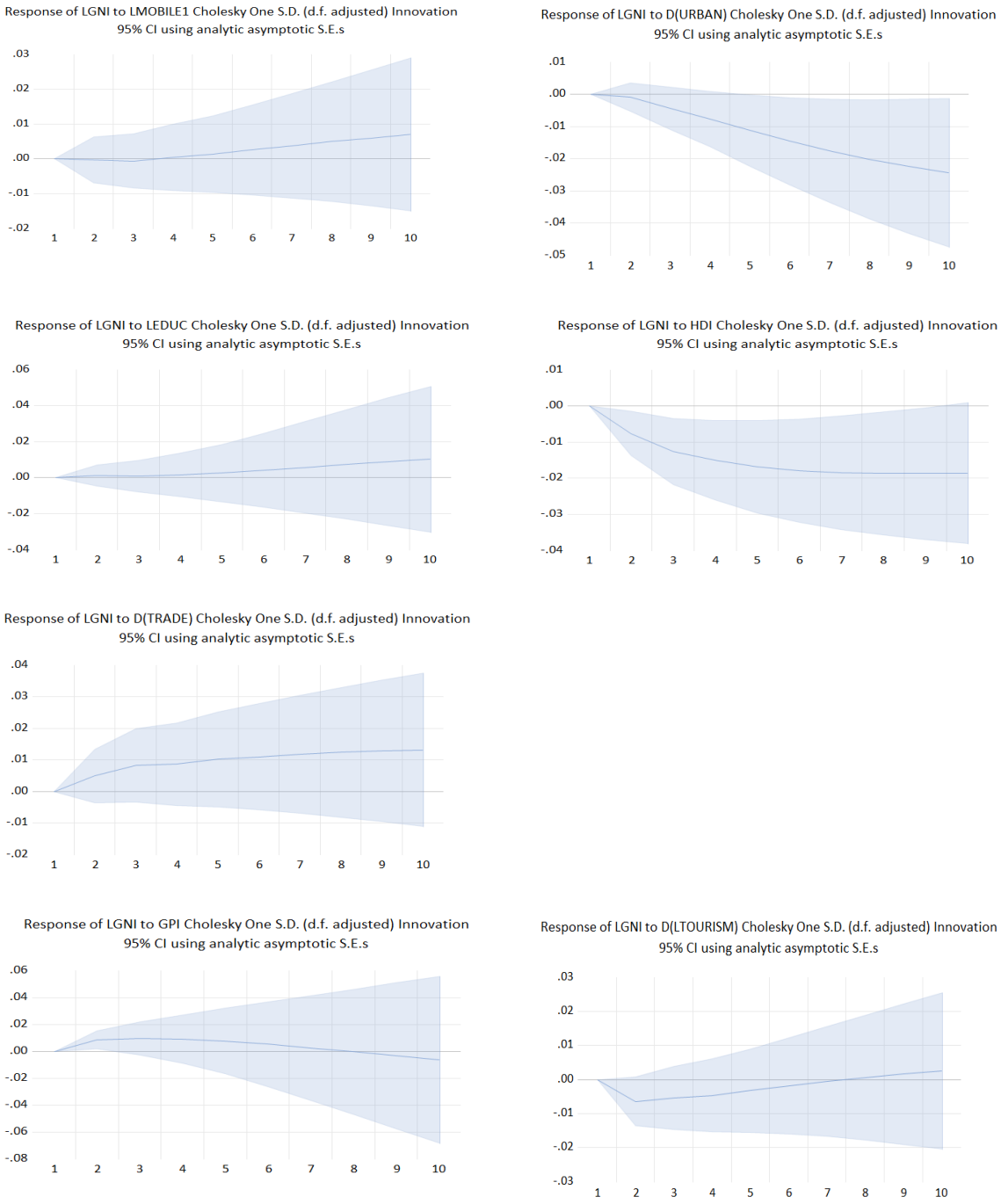

Figure 2: Impulse response function of LGNI to LMobile1, GPI, Leduc, Urban, HDI, Trade, and LTourism chocks from VAR(1) model for UMI countries.

Note: Only response to significant factors which are presented here. Author's computation by Eviews 13.

4) Panel ARDL model and the Long-run Granger Causality from ECM frameworks

The dynamic version of the augmented growth models (Eq (2) or Eq (3)) will be used to estimate the effect of considered independent mixed variables on socioeconomic development for each of the considered groups. But, in a first steps we have to decide if the model is with homogeneous or heterogeneous slopes. After checking the CD (see sub-section 2)), we will check the slope homogeneity among cross-sections. Results are summed up in Table A5 (see Annex).

Looking at Table A5, the Swamy (Pesaran and Yamagata / Blomquist, Westerlund (BW))' Δ and Adj Δ test statistics give different results for both groups: the first group of high income (10 HI) countries, and for the second group of the middle upper income (8 MUI) countries. If the statistic is not sufficiently large to reject the null of slope homogeneity at 5% level, we run a model with homogenous slopes for long-run coefficient of the cointegrating equation and we consider the heterogeneous slope model in the opposite case. Since we get mixed results, we'll consider heterogeneous and homogeneous panel estimation techniques for the ARDL family models. More details are given in the note of Table A5 about the considered baseline static linear models for each group of countries.

Results from homogeneous slopes case

Using the hypothesis that the adequate ARDL model has *homogeneous slopes*, the *long-run* Granger non causality test results based on the PMG estimation are summed up in Table 6. For space limitation, we present only the t statistics and their p-values for the significant adjustment coefficients φ for the *long-run causal relationships* analysis that confirm also the long-run association (cointegration) among variables.

For the first group (of HI countries), looking at Table 6, socioeconomic development (LGNI) is found to be predictable by all considered variables except LifeExpectation, Urban, UI, Netread, Tourism, and Trade.[8] However, for the second group (of UMI countries), LGNI can be predicted only by 5 out of the 14 considered variables.[9]

The *negative* and significance of some adjustment coefficients ρ for both groups indicates that there are several *long-run causal relationships*. Precisely for the first group (second group), there are *unidirectional causality* from Leduc, HDI, LMobile1, GPI, LL, LK, Unemp, and LVAA (HDI, LMobile1, UI, LL, and LK) to the socioeconomic development in the long-run.

[8] Looking at the *long-run* results, all significant variables have positive effects except Unemp and LVAA. However, in the *short-run*, results say that HDI, LL, and Unemp have positive effects, while the remaining variables have *short-run* negative effects. These results are not reported for space limitation but are available upon request.

[9] In the long-run, LMobile1, HDI, and LL have positive effects, while UI and LK have negative effects. The same results are found for the *short-run* effects except for LMobile1 and LK. These results are not reported for space limitation but are available upon request.

Table 6: Long-run Granger Causality Test Results from the PMG estimation results

		Group 1		Group 2	
Factors	**Null hyp**	**ECT φ**	**p-value**	**ECT φ**	**p-value**
Demographic	LEDUC↛LGNI	-0.46855	(0.0027)		
	HDI↛LGNI	-0.64282	(0.0003)	-0.79324	(0.0003)
Politic	GPI↛LGNI	-0.16789	(0.0006)		
ICT	LMOBILE1↛LGNI	-0.84982	(0.000)	-0.86212	(0.000)
	UI↛LGNI			-0.9528	(0.000)
Economic	LL↛LGNI	-0.62015	(0.000)	-0.93046	(0.000)
	LK↛LGNI	-0.41844	(0.0299)	-0.61924	(0.000)
	LVAA↛LGNI	-0.8434	(0.000)		
	UNEMP↛LGNI	-0.71818	(0.000)		

Note: Only significant results are reported. This is done by Eviews.

Results from heterogeneous slopes case

Using the hypothesis that the adequate ARDL model is with *heterogeneous slopes*, the MG estimation results are partially summed up in Table 7. To validate the long-run correlation amongst the variables, a causal relationship will be determined using the panel Granger causality based on ECM form of the general version of the panel ARDL model (Eq(4)). Practically, we used dynamic ARDL version of considered models for the Swamy and BW tests application as given in the note of Table A5 (see Annex).
Again, for space limitation, we present only the t statistics and their p-values for the adjustment coefficients φ for the analysis (see Table 7). Results about long-run and short-run effects of considered variables are available upon request. The short-run error correction term (speed of adjustment φ) is significantly negative for several models, confirming the cointegration relationship between the variables of interest and implying that the causality from the explanatory variables to LGNI is confirmed. Only significant results are given in Table 7. Looking at Table 7 (Panel A), results say that all considered variables:

- political factor: peace index (GPI);
- information and communications technology factors: LnetRead, LMobile1, and UI;
- Demographic factors: LifeExp, LEduc Urban, and HDI; and
- Economic factors: Trade, LTourism, LVAA, Unemp, LL, and LK

Granger cause the socioeconomic development for the HI countries (group 1), while for the UMI countries (group 2) socioeconomic development is not Granger caused by the following 6 variables: HDI, LTourism, Trade, LVAA, LL, and LK (Table 7 Panel B).
For each group, details of these results are presented by country in Table A6 (see Annex).

Table 7: Sum up of Table A 6

Panel A: Group 1 (10 HI countries) results

Country	Significant causation	Long-run significant factors
E A U	...	
Bahrain	Urban, LVAA	Demographic, Economic
Iran	UI, HDI LL	ICT, Demographic, Economic
Koweit	(LMobile1, LNetRead), (Ltourism, TRADE)	ICT, Economic
Libanon	(LMobile1, UI), (LEduc, HDI), (Urban, Unemp, LVAA), GPI	ICT, Demographic, Economic, Politic
Libya	LK	Economic
Oman	(LMobile1, LNetRead), (LLifeExp, HDI)	ICT, Demographic
Qatar	...	
SA	HDI, (Unemp, LVAA) ,GPI,	Demographic, Economic, Politic
Türkiye	(LEduc, Urban), (Unemp, LK), GPI ,	Demographic, Economic, Politic

Panel B: Group 2 (8 UMI countries) results.

Country	Significant causation	Long-run significant factors
Algeria	(LMobile1, LNetRead), (LEduc, Urban) GPI	ICT, Demographic, Politic
Egypte	(UI ,LNetRead), (LEduc, Urban) Unemp	ICT, Demographic, Economic
Iraq	(LMobile1, LNetRead), (Urban, LLifeExp)	ICT, Demographic
Jordan	Urban, Unemp	Demographic, Economic
Morocco	LMobile1, LEduc, GPI	ICT, Demographic, Politic
Mauritania	…	
Syria	UI	ICT
Tunisia	LNetRead, LLifeExp, Unemp	ICT, Demographic, Economic

Note: SA: Saudi Arabia

Looking at Table 7, long-run prediction of socioeconomic development for three countries (including EAU, Qatar, and Mauritania) is independent from all considered factors.

3.4 Sum up and Results Discussion

Looking at Table 8, we do observe some significant differences between HI and UMI MENA countries in terms of causality linkages between socioeconomic development and the 4 groups of selected factors (including ICT, political, demographic, and macroeconomic indicators) for the period 2008-2021.

With respect to the descriptive data analysis, results from ANOVA test confirm difference between the two groups in all considered variables except for the capital K, while results from correlation matrices, association between output and ICT and demographic factors is confirmed for both groups. Furthermore, economic factor is found to be associated to socioeconomic development only for the second group of UMI countries (see Table 8 Panel A).

On the other hand, *at least one of the considered economic* factors (LTourism, VAA, Trade, Unemp, LK, LL) is found to be a predictor for socioeconomic development for both group via *all considered inference technics* (see Table 8 Panel B).

Looking at Table 8 Panel B, based on Pairwise short-run Granger non causality test, for both group, socioeconomic development is affected by LVAA factor (and Tourism for the first group). For HI countries, socioeconomic development is affected in addition by *politic* factor

(peace), while for UMI countries, socioeconomic development is affected as well by *demographic* factors (Education, LifeExp, and HDI).

Using D-H test and Granger non causality test within the VAR model, *at least one of the considered* ICT factors (LMobile1, UI, LnetRead) is found to be a short-run predictors of socioeconomic development for both groups. In addition, the socioeconomic development for UMI countries is found to be affected as well by political (peace) and demographic (HDI, LEduc, Urban) factors in the short-run.

For long-run results, more adequate models (panel ARDL type models) are considered. Based on the *homogenous slopes* version of the PARDL model, all considered factors are found to have long-run causal effect on socioeconomic development for the first group. The same result is valid for the second group except for the politic factor (peace).

In light of the *heterogeneous slopes PARDL* model results, we deduce what can drive the previous conclusions by country in the long-run. Indeed,

- For the first group: All HI countries have socioeconomic development caused in the long-run by
    - Demographic factor (except for Koweit and Lybia)
    - Economic factors except for Oman.

Based on this outcome, it is worth concluding that some HI countries have socioeconomic development affected in the long-run by ICT factors (specifically Iran via UI, Koweit and Oman via LNetRead and LMobile1, and Libanon via LMobile1 and UI) and some others' socioeconomic development are effected by politic factor (peace) including Libanon, Saudi Arabia, and Türkiye in the long-run.

- For the second group: All the UMI countries have socioeconomic development affected in the long-run by
    - ICT factors except for Jordan
    - Demographic factors except for Syria.

Again, some UMI countries have socioeconomic development affected by economic factors in the long-run (specifically, for Jordan, Egypt, and Tunisia via unemployment) and some others are effected by politic factor (peace) (specifically, Algeria and Morocco).

Table 8: Sum up of the comparative investigations

Panel A: Sum up from data exploration

Technics	**Group 1** of HI countries	**Group 2** of UMI countries
ANOVA test	All except LK	
Correlation matrix	ICT and Demographic factors	ICT, Economic, and Demographic factors

Panel B: Sum up of Significant factors via Granger non Causality test Results

Short-run results		
Causality tests	Group 1 of HI countries	Group 2 of UMI countries
Pairwise (Granger, 1969) causality test	Politic and Economic factors	Demographic and Economic factors
(Dumitrescu and Hurlin, 2012) panel Causality Tests	ICT and Economic factors	∅
VAR and the Block Exogeneity Wald Tests	ICT and Economic factors	ICT, Politic, Demographic, and Economic factors
Long-run results		
Granger Causality from ARDL with *homogenous* slopes	ICT, Politic, Demographic, and Economic factors	ICT, Demographic, and Economic factors
Granger Causality from ARDL with *heterogenous* slopes	• Demographic factors: for all countries except Koweit* and Lybia* • Economic factors: for all except Oman* • ICT factors: only for Iran, Koweit*, Libanon, and Oman* • Politic factors: only for Libanon, SA*, and Türkiye	• Demographic factors: for all countries except Syria • Economic factors: for only Jordan, Egypt, and Tunisia via unemplyment • ICT factors: for all except Jordan • Politic factors: only for Algeria* and Morocco

Note: Saudi Arabia (SA). *: is to indicate oil exporting countries.

4. Conclusion and policy implementation

In this paper, the socioeconomic development can be seen as a process of changes or improvements in social and economic conditions as they relate to the country or a group of countries (Roztocki & Weistroffer, 2016; Roztocki, et al., 2019).

The present study tried to assess the causality linkages between socioeconomic development and the *technological* factors (Mobile-cellular telephone subscriptions, internet usage, network readiness), the *political* factors (peace), the *demographic* factors (education, life expectancy, urbanism, Humain Development), and the *economic* factors (agriculture production, tourism, trade, unemployment; Labor force, Gross capital formation) in 19 countries from MENA zone during the period from 2008 to 2021. MENA countries are classified by output level high income (HI) and upper middle income (UMI).

Due to serious data limitations for the region, we are restricted in the choice of 19 countries (10 high income (HI) level countries and 8 upper middle income (UMI) level countries (Yemen is dropped from the sample since it is the unique which belong to the Lower-middle-income level group of countries)).

Besides econometrics investigations, we have done a priori data comparison analysis which is based on the ANOVA test and the correlation matrices.

Using different econometric technics for the 18 MENA countries over the period 2008 to 2021, the results suggest that each of the considered factor can be important in boosting socioeconomic development in the region. Furthermore, to check the impact of different factors on socioeconomic development, the results on splitting sample in HI level and UMI level MENA countries shows that there is statistically significant difference between HI level and other MENA countries in terms of the impact of considered factors.

Hence, by comparing between the results of four different econometric techniques (namely the pairwise (Granger, 1969) causality test, the (Dumitrescu and Hurlin, 2012) panel causality tests, the Block Exogeneity Wald Tests (within the VAR model), and the Granger Causality from the ECM framework of the ARDL (*homogenous* or *heterogenous* slopes)), we would like to humbly recommend the following policies toward the process of socioeconomic development undergone by the MENA region set of the 18 countries included in this study.

In light of the empirical findings, policymakers need to navigate the complex terrain of socio-economic development indicators by focusing on initiatives that manage human development and socio-political stability, improve technology information and communication outcomes and invest in employment opportunities, to provide exploitable prospects playing a decisive role in promoting short- and long- term projects in the prosperity of national and regional socio-economic development. The results also contribute to academic discourse.

Particularly, it is possible to amplify the role of the aforementioned factors in the socioeconomic development process by formulating policies (or low) aimed at

- reducing the rates of unemployment in case of UMI countries (specifically for Jordan, Egypt, and Tunisia),
- strengthen peace for both groups, specially between Algeria and Morocco, and for Lebanon, Saudi Arabia and Türkiye environment,
- promoting the ICT factors for almost all considered countries, and
- promoting the demographic factors for HI countries and particularly for Koweit and Lybia.

Our paper explored the central question of assessing the determinants of the socioeconomic level of 19 countries. We used different approaches in order to look for results' convergence and support our conclusions and reach findings that are more robust. Our study is among the first works to explore such question for MENA area. Hence, we propose our findings as initial ground that needs further confirmation in future research by utilizing larger dataset, longer data frame, and additional models.

In this paper, we provided a conceptual framework that considered four dimensions that impact socioeconomic development: policy, technology, demography, and macroeconomic. Thus we are confident that our framework will serve as an aide to future researchers in focusing their work, dealing with the 4 considered group of factors for socioeconomic development. However,

it is essential to acknowledge the limitations of our study including potential omitted variables as ones related to environmental security. Future research could explore in addition a required comprehensive study of other macroeconomic indicators impact like money supply, exchange rates and inflation rates in order to further assess the country's economic development.

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Annex: Some Tables

Table A1: List of variables, definitions and sources

Variables	Description	Source
Log(GNI)	GNI per capita PPP (based on purchasing power parity) measured in current international $	https://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD
Log(VAA)	Agriculture, added value (% of GDP)	
Technological factors		
Log(Mobile1)	Mobile-cellular telephone subscriptions; by postpaid/prepaid	https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
UI	Individuals using the Internet (% of population)	https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
Log(NetRead)	Network Readiness index (Technology Readiness) as proxy for information and communication technology usage in the country	http://reports.weforum.org/global-information-technology-2011/
Political factors		
Peace	Peace Index (global peace index GPI)	http://visionofhumanity.org/indexes/global-peace-index/
Demographic factors		
Log(Educ)	Education Index (mean years of schooling **and** expected years of schooling in the country)	http://hdr.undp.org/en/content/education-index
LifeExp	Life Expectancy (life expectancy at birth in the country derived from different sources and aggregated in World Bank data)	http://hdr.undp.org/en/content/education-index
Urban	Urban population (% of total population)	https://data.worldbank.org/indicator/SP.DYN.LE00.IN
HDI	Humain Development Index	https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS
Economic factors		
Unemp	Unemployment, total (% of total labor force) (modeled ILO estimate)	https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS
Log(Tourism)	Percent of tourism per capita (number of arrivals or tourists per capita in the country) International tourism, number of arrivals	https://data.worldbank.org/indicator/ST.INT.ARVL
Trade	Trade (% of GDP)	http://wits.worldbank.org/visualization/openness-to-trade-visualization.html
LL=log(Labor)	Labor force participation rate is the proportion of the population ages 15-64 that is economically active: all people who supply labor for the production of goods and services during a specified period.	World Bank, World Development Indicators (WDI)
LK=log(GCF)	Gross capital formation (% of GDP).+	WDI

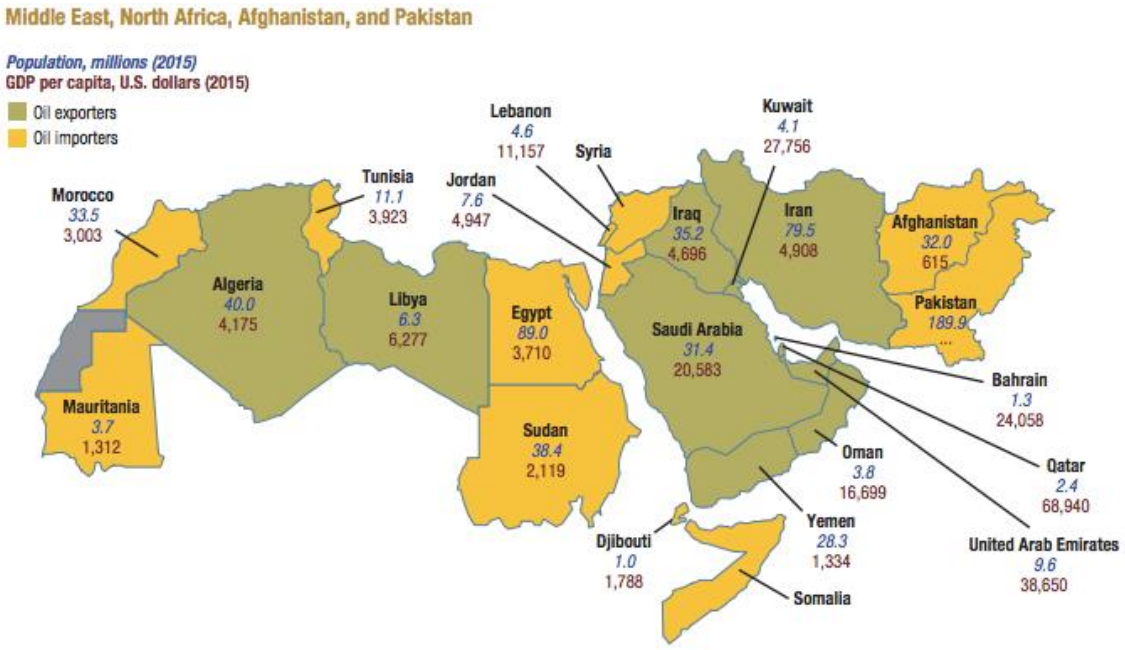
Table A2: Income group classification

ClassWB	**Income group**	**Source**
Class 4: Low-income	~< $1035	World Bank (WB)
Class 3: Lower-middle-income	$1036–$4085	
Class 2: Upper-middle-income	$4086–$12,615	
Class 1: High-income	$12,615 > ~	

Table A3: Country list (19 from MENA zone during 2008-2021)

Num/Country codes	Average of VAA	Country	Average of income	Income group
1 EAU	0,7686965	Emirats Arabes Unis*+	63152,9	High-income
2 BHR	0,29603	Bahrain*+	43474,1	High-income
3 IRN	9,142292	Iran*	13178,9	High-income
4 KWT	0,41141	Koweit*+	59950,2	High-income
5 LBN	3,39607	Libanon	15093,9	High-income
6 LBY	3,064037	Libya*	13338,8	High-income
7 OMN	1,596067	Oman*+	31680,8	High-income
8 QAT	0,1725096	Qatar*+	90019,4	High-income
9 SAU	2,390629	Saudi Arabia (SA)*+	48203,1	High-income
10 TUR	6,929357	Turkiye	26613,7	High-income
11 ALG	10,59615	Algeria*	11199, 4	Upper-middle-income
12 EGY	11,93176	Egypte	10424	Upper-middle-income
13 IRQ	4,306026	Iraq*	10189,5	Upper-middle-income
14 JOR	3,974305	Jordan	10074,7	Upper-middle-income
15 MAR	11,80357	Morocco	7000,4	Upper-middle-income
16 MRT	19,19727	Mauritania	4939,2	Upper-middle-income
17 SYR	29,33476	Syria	5170,2	Upper-middle-income
18 TUN	8,747193	Tunisia	10638,7	Upper-middle-income
19 YEM	13,60269	Yemen	1910,1	Lower-middle-income

Note : 10 countries with high-income, 8 with upper-middle-income, one with lower-middle-income, and zero with low-income in N=19 considered countries. *: belong to oil exporting countries (see Figure A1 here after). +: belong to GCC.
Source: Author's computation.



Sources: IMF Regional Economic Outlook database; and Microsoft Map Land.
Note: The country names and borders on this map do not necessarily reflect the IMF's official positions. The gray area on the map denotes disputed territory.

Figure A1:MENA zone.

Table A4: List of studies assessing the impact of different factors on economic growth

Authors	Sample	Years	Methods	Main results/conclusions
(Ngwenyama, O., Andoh-Baidoo, F. K., Bollou, F., & Morawczynski, O, 2006)	Senegal, Niger, Benin, Cameroon, Benin	1993-2003	OLS	The variables are significant in predicting the HDI score. ICT and education have a positive impact on development.
(Andoh-Baidoo, F. K., Osatuyi, B., & Kunene, K. N, 2014)	53 African States	1990-2008	OLS	A combination of political, economic, human development endowment, and population factors influence ICT capacity.
(Sağlam, B. B, 2016)	34 OECD countries	1990-2012	VAR	A bidirectional causal relationship between ICTs and economic growth has been identified..
(Salahuddin, M., Gow, J , 2016)	South African	1991-2013	ARDL	The results showed a significant positive effect of the internet on economic growth.
(Niebel, T, 2018)	59 countries	1995-2010	Panel regression	Results indicated that ICT has a positive impact on economic growth in developing countries.
(Maurseth, P.B, 2018)	171 countries	1990-2015	OLS, and panel GMM	The findings recorded a significant negative impact of internet usage on economic growth.
(Haftu, G.G, 2019)	40 Sub-Saharan African countries	2006-2015	GMM	Results showed the absence of a significant impact of ICT on economic growth.
(Mohammed, Rezgar, 2020)	7 countries (Algeria, Egypt, Jordan, Mauritania, Morocco, Sudan, and Tunisia)	1980-2018	ARDL	The variables (agricultural value–added, the exports of goods and services, the terms of trade) had a positive and significant impact on net economic growth.
(Tahir, Muhammad and Azid, Toseef, 2015)	50 developing countries (including Algeria, Egypt, Morocco, Sudan, and Tunisia)	1990-2009	(OLS) and (2SLS)	Domestic capital formation, labor force, and trade openness had a positive and significant impact on economic growth. But, inflation had a significant negative impact on economic growth.
(Islam, Faridul; Hye, Qazi Muhammad Adnan; and	62 countries (including Algeria, Egypt, Iran,	1971-2009	ARDL	Results indicated the existence of a positive link between the imports of goods and services and economic growth (in the case of Algeria and Egypt) when GDP was treated as the dependent variable.

Shahbaz, Muhammad, 2012)	Mauritania, Morocco, Sudan, and Tunisia)			
(Duncan, Felina B. and Denaux, Zulal, 2013)	7 MENA countries (Algeria, Egypt, Jordan, Morocco, Saudi Arabia, Syria and Tunisia	1970-2010	OLS	The results exposed that the initial level of income and the degree of trade openness had a negative impact on economic growth. In case the country was classified as a major oil producer, the respective estimate was positive.
(Uddin, A., Masih, M. , 2016)	16 Organisation of Islamic Cooperation countries	1990-2011	Dynamic regression analysis	Political stability positively affects economic growth.
(Balcı, E. and Özcan, S, 2019)	54 OIC countries (The Organization of Islamic Cooperation)	2005-2017	Panel data	Results showed a significant relationship between economic growth and human development in OIC countries.
(Mykola Pasichnyi and Anton Nepytaliuk , 2021)	45 advanced and emerging market economies	1990-2018	Panel data method	An essential increase in life expectancy adversely affected the real GDP per capita growth rate. The empirical investigation pointed out that the above demographic variable was strongly linked to nominal GDP per capita.
(Gulcemal, Tuba, 2020)	16 developing countries	1990-2018	The panel data	The results suggested the existence of a positive and significant impact of human development on economic growth and development in developing countries. Labour has a positive and significant relationship with growth.
(Ngwen Ngangue and Kouty Manfred (2015), 2015)	141 developing countries (DC)	2000-2013	A dynamic panel	Life expectancy affected positively economic growth in DC. However, the results are mixed when classifying DC according to their level of income, the effect is not significant in the middle-income DC.
(Muhammad Shahid, 2014)	Pakistan	1980-2012	VECM	Economic growth has insignificant negative, gross fixed capital formation has significant positive and labour force participation has significant negative relationship in short run.
(Ahasan Ul Haque, Golam Kibria, Muhaiminul Islam Selim and Dilruba Yesmin Smrity, 2019)	Bangladesh	1991-2017	Annual time series data	Total labor force participation and female labor force participation have short-run positive significant effects on the economic development but adverse effects in the long run. On the contrary, gross fixed capital formation contains short term significant negative indication on the economic growth but has an explicit positive considerable impact on the economic development.
(Jayaraman, T.K., Makun, K., 2022)	Six South Asian countries	1995-2018	Nonlinear econometric methodology	This study confirmed the existence of an asymmetric association between tourism and economic growth and concluded a positive partial-sum decomposition of tourism increased economic growth. The negative-sum decomposition of tourism had a much greater adverse effect on economic growth.

Table A5: Results of slope homogeneity tests

	Group 1		Group2		Group2	
	Stat	p-value	Stat	p-value	Stat	p-value
Models	Eq **(1.1)**				Eq **(4.2)**	
(Swamy, 1970) Δ	-0.730	0.465			-1.914	0.056
(BW. 2013) Δ_{HAC}	-1.968	0.049			-3.290	0.001
Models	Eq **(2.1-2)**		Eq **(2.1-2)**		Eq **(5.2)**	
(Swamy, 1970) Δ	-0.686	0.493	-3.156	0.002	-2.551	0.011
(BW. 2013) Δ_{HAC}	1.494	0.135	-3.864	0.000	-2.421	0.015
Models	Eq **(3.1-2)**		Eq **(3.1-2)**		Eq **(6.2)**	
(Swamy, 1970)						
Δ	0.635	0.526	-2.285	0.022	-1.167	0.243
Adj Δ	1.982	0.047			5.475	0.000
(BW. 2013)						
Δ_{HAC}	-1.888	0.059	-0.870	0.384	-1.012	0.312
Adj Δ_{HAC}	-5.896	0.000			-4.744	0.000

Note: Based on correlation matrix results, we propose several baseline models for homogeneity test application. For the first group (of HI countries), LGNI is significantly correlated with LMobile1, UI, and HDI. But, since UI (HDI) and LMobile1 are correlated, we proposed three linear static models:

Eq (1.1) $LGNI = F(LMobile1)$

Eq (2.1-2) $LGNI = F(UI)$

Eq (3.1-2) $LGNI = F(HDI)$.

These models are augmented by some variables from

$$Z1 = (LNetRead, dGPI, LEduc, LifeExpG, Urban, DUnemp, Trate, VAAG)$$

which are not correlated with LMobile1 in Eq (1.1) (with UI in Eq (2.1-2) and with HDI in Eq (3.1-2)) and each variable from Z1 that is non correlated with the others. Using OLS regression technic and the VIF criteria, Eq (1.1), Eq (2.1-2) and Eq (3.1-2) are augmented respectively by (All VIF values are < 5):

$$Z1{,}1 = (LNetRead, dGPI, LEduc, LifeExpG, Urban, DUnemp, Trate)$$

$$Z1{,}2 = (Z11, VAAG)$$

$$Z1{,}3 = (LNetRead, dGPI, LifeExpG, DUnemp, TourismG, Trate, VAAG)$$

For the second group (of UMI countries), GNI is significantly correlated with UI, LEduc, LifeExpG, HDI, and Trade. Again, since these variables are correlated, they cannot be in the same regression, so we proposed five linear static models. Besides Eq (2.1-2) and Eq (3.1-2) as for the first group, we propose

Eq (4.2) $GNI = F(Educ)$

Eq (5.2) $GNI = F(LlifeExp)$

Eq (6.2) $GNI = F(Trade)$

Again, models (2.1-2) to Eq (4.2) are augmented by some variables from

$$Z2 = (LMobile1, LNetRead, dGPI, Urban, DUnemp, TourismG, VAAG)$$

which are not correlated with UI in Eq (2.1-2) (Leduc in Eq (4.2), LifeExpG in Eq (5.2), HDI in Eq (3.1-2), and Trade in Eq (6.2)) and each variable from Z2 that is non correlated with the others. Also, using OLS regression technic and the VIF criteria, Eq (2.1-2), Eq (3.1-2), Eq (4.2), Eq (5.2) and Eq (6.2) are augmented respectively by (respective VIF are all < 5):

$$Z2{,}2 = (LMobile1, LNetRead, dGPI, Urban, DUnemp, TourismG, VAAG)$$

$$= Z2{,}3 = Z2{,}4 = Z2{,}5$$

and

$$Z2{,}6 = (LNetRead, dGPI, Urban, DUnemp, TourismG, VAAG).$$

For (Swamy, 1970), H_0: slope (cointegrating) coefficients are homogenous (is improved by (Pesaran and Yamagata 2008) to allow for autocorrelated error case) and is done by STATA. The 3 first tests ((Δ and Adj Δ test statistics) are done by Eviews using optimal $lag = 1$. The latest tests (BW) proposed by (Blomquist, Westerlund. 2013) are the Heteroskedasticity and autocorrelation consistent (HAC) robust version of slope homogeneity test of Pesaran and Yamagata (Δ_{HAC} and Adj Δ_{HAC} test statistics) and are done by STATA. If H_0 is rejected, then one can use heterogeneous panel estimation techniques (Mean Group (mg) family models). In the opposite case, one can consider rather Pooled Mean Group model (pmg).
Source: Author's computation.

Table A6: Granger causality test results based on the ECM model (Eq(4))

		Group 1 (10 HI countries)			
Null hyp	**Country**	ECT φ	**Null hyp**	**Country**	ECTφ
LEDUC↛LGNI	Turkey	-1.80682	HDI↛LGNI	Libanon	-1.18741
		(0.000)			(0.000)
	Libanon	-.96277		Oman	-1.02719
		(0.000)			(0.000)
GPI↛LGNI	Turkey	-1.5492		Saudi Arabia	-.415773
		(0.000)			(0.075)
	Libanon	-1.26806		Iran	-.973058
		(0.000)			(0.000)
	Saudi Arabia	-.548589	Ltourism↛LGNI	Kuweit	-1.30621
		(0.000)			(0.000)
LLIFEEXP↛LGNI	Oman	-1.27238	LNetRead↛LGNI	Kuweit	-.575624
		(0.000)			(0.000)
LMOBILE1↛LGNI	Oman	-.814965		Oman	-.947917
		(0.002)			(0.000)
	Libanon	-1.15788	UNEMP↛LGNI	Turkey	-1.45617
		(0.000)			(0.000)
	Kuweit	-1.0271		Saudi Arabia	-1.06987
		(0.000)			(0.000)
UI↛LGNI	Libanon	-1.11426		Libanon	-1.16159
		(0.000)			(0.000)
	Iran	-.945361	TRADE↛LGNI	Kuweit	-.776755
		(0.000)			(0.000)
LL↛LGNI	Iran	-.98142	Urban↛LGNI	Bahrain	-1.26312
		(0.000)			(0.000)
LVAA↛LGNI	Bahrain	-.90332		Libanon	-1.31373
		(0.000)			(0.000)
	Libanon	-1.00458		Turkey	-1.02658
		(0.000)			(0.000)
	Saudi Arabia	-.714713	LK↛LGNI	Libye	-1.00107
		(0.000)			(0.000)
				Turkey	-1.14787
					(0.000)

Group 2 (8 UMI countries)

Null hyp	**Country**	ECT φ	**Null hyp**	**Country**	ECT φ
LMOBILE1↛LGNI	Morocco	-1.16675 (0.000)	LNetRead↛LGNI	Algeria	-1.48863 (0.000)
	Iraq	-.930812 (0.000)		Egypt	-1.05117 (0.000)
	Algeria	-1.08509 (0.000)		Irak	-1.25884 (0.000)
UI↛LGNI	Syria	-1.07879 (0.000)		Tunisia	-2.12257 (0.000)
	Egypt	-.98897 (0.000)	GPI↛LGNI	Algeria	-.855021 (0.000)
LEDUC↛LGNI	Algeria	-.965884 (0.000)		Maroc	-2.386 (0.000)
	Egypt	-1.43731 (0.000)	LLIFEEXP↛LGNI	Irak	-1.4372 (0.000)
	Maroc	-4.1371 (0.000)		Tunisia	-1.3124 (0.000)
Urban↛LGNI	Algeria	-.816277 (0.000)	UNEMP↛LGNI	Egypt	-1.60467 (0.000)
	Egypt	-1.74639 (0.000)		Jordan	-1.37511 (0.000)
	Irak	-1.58761 (0.000)		Tunisia	-2.07584 (0.000)
	Jordan	-1.186 (0.000)			

Note: (.) is the p-value. Only significant results for adjustment coefficient ρ which are presented in this table. Null hypothesis is rejected in each of these cases. ECT φ: is for t statistic and its p-value for the adjustment coefficient φ.This is done by STATA. Source: Author's computation.