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Knowledge Diaspora and the Dynamic Convergence: A Wavelet Intuition using Bootstrapping Methodology

Khizra Sardar (Corresponding Author)
PhD Scholar of Economics, The Women University, Multan
khizrasardar42@gmail.com
Hina Ali
Associate Professor, The Women University, Multan
hinaali@wum.edu.pk

ABSTRACT

With increased globalization knowledge diaspora has been intensified greatly, particularly in developing economies like Pakistan. Since the post-Covid-19 era, an upward wavelet trend of international labor mobility has been witnessed in Pakistan. This captures researcher attention towards this phenomenon. The dynamic convergence has been decoupled into five major pull-constructs namely economic stability (GDPP), socio-economic stability (EMP), financial stability (DCP), economy's openness (TRD), and the environmental quality (RNEW). While knowledge diaspora has been categorized based on acquired skills, into seven different skill-types. This research initialize an aggregate analysis for the integration of total migration flow (LT) and the net-migration flow (N.Mig). The decomposition of empirical methodology into disaggregate and aggregate analysis, is to highlight the prevailed heterogeneity of pull-drivers. For statistical investigation, various analysis techniques namely unit root testing, regression bootstrapping, consistent "partial-least-square & structural-equation modeling" (PLS-SEM), convergent validity-&-reliability, and the HTMT discriminant ratio has been employed. Conversely, the influence of remittance and globalization as a mediating construct for international migration and the dynamic pull-drivers has also been analyzed. This research entails a comprehensive deductive-methodology concerning knowledge-diaspora and dynamic convergence of Pakistan. A time series data has been compiled over the time-span of 1976-2025. The findings postulates that aggregate-analysis provides a complex yet mixed effects, thus for an in-depth inside disaggregate-analysis must be considered. The static role of pull-indicator has been witnessed for multiple migration-types. This signifies that Pakistan's economy holds the potential for dynamic convergence which in turn pull-backs the international migration outflow. The most static influence has been captured by socio-economic stability (employment level) and the environmental quality (renewable energy consumption). While, credit providence for domestic-investors (DCP) has been emerged as another imperative pull-construct for dynamic convergence. Therefore, policymakers must consider the environmental constructs along with socio-economic stability while forming diminution policies for knowledge transfer or international labor migration.

Keywords: *International Migration, net migration, macro-economic performance, pull-drivers, regression, bootstrapping, Pakistan, and PLS-SEM.*

Introduction

The subsequent section has been constructed for deliberating a brief description (definition) or introduction to the examined empirical indicators mainly knowledge diaspora and the

dynamic convergence. The term international migration, human-capital flight, or knowledge transfer (knowledge diaspora) usually replicates the transfer, flight, or movement of a country's labor outside the national border. The in-side transfer (or inflow) of labor migration falls in the category of refugees and asylum seekers. According to Cambridge dictionary (2019) brain drain refers as a situation in which large no. of educated and highly skilled (very skilled) individuals leave their home entity to live and work in another state or economy where wage and living conditions are better than their home entity.

It occurs due to multi convulsions (such as social, political and macro-economic disruptions) within an economy, lack of adequate health, education and other sort of facilities, poverty, availability of favorable job opportunities, desire to avail better living standard, economic landscape and many others. The migration might be involuntary or voluntary(International labour organization, 2017; and International labour organization, 2018). Involuntary immigration contains *'forced displacement'* in numerous forms such as slave trade, trafficking of humans, deportation and *'human flight'* in form of ethnic cleansing, war refugees. Researchers has discriminated major three types of migrants which are labor migrant, refugee migrant, and third one is urbanization (millions Agri. workers left countryside, migrate to cities (Global Migration Indicators, 2018; and World Bank, 2018).

This activity instigated in Britain in 18th century and then passes to the world). In accordance to desire and will, migration might be *'self-selected'* developed from numerous purposes such as education, job, tour and so on. and *'non-self-selected'* resulted from political instability, natural disasters and war (Solimano, 2002; and Özden, & Schiff, 2005). In this research, the international mobility has been decomposed into seven sub-domains that are highly-qualified (LHQ), highly-skilled (LHS), skilled (LS), semi-skilled (LSS), un-skilled (LUS), total migrants (LT), and net migrants (N.Mig). The LHQ, LHS, LS, LSS, and LUS constitutes a dis-aggregate analysis for international migration while LT and N.Mig replicates an aggregate analysis estimation (Ejaz et al., 2022).

Conversely, the term dynamic convergence as it name displays integrates or examines numerous macro-economic indicators which assist an economy to transform or converge into a developed one. The impact of dynamic convergence on knowledge diaspora is of complex nature and still in debate among researchers. Although, most of them utilizes dynamic convergence as an aggregate (by using economic growth), a little work has been done on dis-aggregate estimation. By considering this, researcher has sub-divided dynamic convergence into five major components that are labelled as pull-drivers. In literature examination, one can explicate a vast list of macro-economic performance pull indicators, filled with wealth of acknowledgement concerning major macroeconomic pull-metrics and their empirical investigation (Kwilinski et al., 2022; and Ejaz et al., 2022).

Conversely, some major dynamic convergence pull indicators, which shines on top in literature are economic (GDP) growth, unemployment, inflation, and balance of trade (i.e., current account balance). Though, in recent literature some studies shows that environmental performance and climate change is also contributing as a push indicator for international migration. They labeled this integration as "climate migration" or "environmental refugees". Similarly , some major macro-economic pull indicators, which shines on top in literature are improved standard of living (GDP per-capita), employment (increased job opportunities), increased investments (by providing capital to domestic private

sector), and international trade (improves current account balance). The impact of all dynamic pull-forces has been analyzed for the international mobility in Pakistan (Kwilinski et al., 2022; and Haq, Kumar, & Kumar, 2024).

Objectives behind the Study

The main goal or the utmost prioritizing objective of this research is to integrate the dynamic association between international labor mobility and the convergence of macro-economic performance. Although, the achievement of this target is entailed with following detailed sub-objectives. These objectives explicates the impact of selected push-drivers as well as pull-drivers on the international mobility of different skill-types. In the following, targeted goals of this dissertation has been deliberated which are:

- Initialize some empirically imperative dynamic pull forces in context of international migration.
- Deliberate the contribution of the dynamic pull-drivers in determining the international labor mobility of different skill-types.
- Disclose the contribution of the dynamic pull-drivers in determining the total migration and the net migration rate.
- Discriminate the degree of influence between the different the pull constructs, in order to highlight the potential of each indicator in context of international mobility.
- Explicate the individual contribution of each pull-construct in explaining international migration in Pakistan.
- Deliberate the internal validity as well as external validity of the examined research models.
- Intensify the mediating role of remittances flow in modifying international migration and the dynamic pull-drivers cointegration.
- Initialize the mediating role globalization in imparting international migration and the dynamic pull-drivers association.
- Disclose new consideration or path for further research.
- Demonstrate possible yet effective solutions for tackling the increased migration outflow from Pakistan.

Hypothetical Examination

The primitive objective behind the conduction of this research is to analyze the dynamic association between the international labor mobility and the dynamic convergence for the case of Pakistan. Conversely, in order to empirically test the cointegration between international migration and the dynamic pull-drivers, this research explicates following research hypothesis which needs to be empirically analyzed. These research hypothesis explicates the impact of selected pull-drivers on the international mobility of different skill-types. In the following, targeted research hypothesis of this dissertation has been deliberated. Following research hypothesis needs to be examined by this research:

This study has been examined to testify the following sets of hypotheses:

1) Hypothesis-01:

- **Null hypothesis-1:** The selected pull-drivers does not significantly determines the international migration of Highly-qualified labor in Pakistan.
- **Alternative hypothesis-1:** The selected pull-drivers significantly determines the international migration of Highly-qualified labor from Pakistan.

2) Hypothesis-2:

- **Null hypothesis-2:** The targeted pull-forces does not significantly determines the international migration of highly-skilled labor in Pakistan.
- **Alternative hypothesis-2:** The targeted pull-forces significantly determines the international migration of highly-skilled labor in Pakistan.

3) Hypothesis-3:

- **Null hypothesis-3:** The specified pull-drivers does not significantly determines the international migration of skilled labor in Pakistan.
- **Alternative hypothesis-3:** The selected pull-drivers significantly determines the international migration of skilled labor in Pakistan.

4) Hypothesis-4:

- **Null hypothesis-4:** The specified pull-drivers does not significantly determines the international migration of semi-skilled labor from Pakistan.
- **Alternative hypothesis-4:** The selected pull-drivers significantly determines the international migration of semi-skilled labor from Pakistan.

5) Hypothesis-5:

- **Null hypothesis-5:** The shortlisted pull-constructs does not significantly determines the international migration of un-skilled labor from Pakistan.
- **Alternative hypothesis-5:** The shortlisted pull-constructs significantly determines the international migration of un-skilled labor from Pakistan.

6) Hypothesis-6:

1. **Null hypothesis-6:** The selected pull-drivers does not significantly determines the international migration of total labor migration from Pakistan.
2. **Alternative hypothesis-6:** The selected pull-drivers significantly determines the international migration of total labor migration from Pakistan.

7) Hypothesis-7:

- **Null hypothesis-7:** The targeted pull-forces does not significantly determines the international migration of net labor migration from Pakistan.
- **Alternative hypothesis-7:** The targeted pull-forces significantly determines the international migration of net labor migration from Pakistan.

This research has been organized in a sophisticated and defined manner, as can be seen in the following sections. This research examines role of macro-economic dynamic pull-drivers in determining international labor migration of Pakistan. Consequently, this research has been classified into six (6) major chapters, each one contains further sub-sections, as demonstrated in below sections;

Literature Review

Özden and Schiff (2005) examined to what extend brain gain occurred through emigration. For empirical approximation, seventy (70) OECD developing economies were selected by the researcher. Study disclosed that size of brain gain was smaller than defined in literature (mobility of brain incurred high gains to an economy). Brain drain has/had affirmed negative effect on human capital stock. Beine, Docquier, and Rapoport (2001); Docquier, and Rapoport (2005); Stark (2004) incited familiar facts in their searches.

Faini (2006) emphasized association amid brain drain and remittances. For empirical approximation, OECD economies were selected by the researcher. Statistical results of this

analysis were that lower earnings (low portion of earned income) were remitted home by emigrants. Because they have to fulfill their own expenses (own consumption). Another drawback of migration explored here was that migrants very often reunited with their close one's or visit their homes very often. Carrington & Detragiache (1999); and Docquier, & Marfouk (2004) studies signified it.

Razin and Binyamini (2007) augmented a flattened trade-off between inflation and output. This paper integrated a disaggregated data series analysis modeling. Here, examined indicators were economic growth (output), inflation, migration, capital mobility, and trade openness for goods. Analysis forecasted that an endogenous monetary policy (determined for natives welfare) aggressively affects inflation fluctuations while benign output-gap in context with an open economy with globalization of in-&-out migrants, capital mobility, and goods trade. Additionally, increased openness will make markup stepper in short run, which may tend to reverse in long run, thus provoking anti-inflation policy.

David and Marouani (2013) agumented the dynamic nexus of international mobility, unemployment, education, and economic growth. Here, examined indicators were education, investment, exchange rate, population, GDP growth, unemployment, remittance, and brain transfer (multiple skill categories). Analysis forecasted that global crisis worsened unemployment and also decreases labor demand in Tunisia. Although, increased foreign wage attracts highly-skilled Jordan labor, causing an induced immigration. Therefore, high-skilled labor got benefits while semi-skilled and low skilled labor suffers with increased unemployment.

Kaplan and Höppli (2017) scrutinized an empirical analysis of brain drain in South Africa. Here, examined indicators were economic growth, financial crisis, and brain drain. In order to conduct statistical analysis, descriptive analysis and trends exhibition were chosen. The findings suggested that net brain drain is albeit slowly while brain gain was quite large as immigrants return to home economy due to global financial crisis. Thus, playing imperative role in South African growth acceleration.

Zhang and Lucey (2019) presented a dynamic nexus of brain transfer, globalization, and GDP growth in case of selected 30-European nations. Here, examined indicators were economic growth, employment, high tech share, per-million patent applications, globalization, and brain drain/gain index. Empirical estimates showed that transfer of graduated migrants tend to incur in the form of loss (drain) for origin developing economies while benefits (gain) developed nations by providing skilled labor without any investment in human capital.

Bongers, Díaz-Roldán, and Torres (2022) anticipated the validation of brain-gain or brain-drain hypothesis. In this scenario, integration of human capital formation has also been tested for both host (USA) and origin economies (in a developed, developing, and then on World's economy). Examined variables here were human capital investment, capital rents, consumption, investment, and labor productivity. Tarek (2023) scrutinized the utilized mechanisms of benefit from Immigration competencies. In this regard, an analytical examination of numerous consequences of brain-drain on developing economies has been analyzed.

Theoretical Framework

William Petty was the first who tried to examine the social value of an individual. He used notion “capital” for humans. William Patty (1662) provoked human capital estimation in

monetary terms and stressed on migration economic effects. According to him, expenses to move persons would be treated as financial investment (Ali, Chaudhry, and Farooq, 2012). Adam Smith (1776) argued that skills of men's, their knowledge and capabilities are identified as imperative qualities or assets of men when deliberating their economic actions. His study advanced the notion that knowledge of workmen is an integral way for technological and innovational change. Though Smith didn't generally utilize the notion ''capital'' for human beings (Smith, 1776; Ali, Chaudhry, and Farooq, 2012).

Fried List (a German economist) in 1841 accentuated the imperative idea that human skills and abilities were mainly the heritage from former to existing generations. According to Marshall an assessment of capital value of an individual might be assessable but he, disregarded the concept of "human capital" impractical because human lives are not calculable or marketable. Therefore, despite classical economists' unforgettable efforts, no reliable model of human capital had been documented before 1960's (Blandy, 1967; and Ali, Chaudhry, and Farooq, 2012). Tech (1988) examined international trade to explain the relations amid 'technical progress' and 'value added per worker'. According to him, accumulation of capital elevated real per worker value added in industries. Moreover, researcher also considered per worker value added and technical progress relation (Tech, 1988).

According to Straubhaar (2000) the central conception in 1950's literature (Hirschman, Perroux, Myrdal, Wallerstein divergence or core-periphery or vicious circle) was that additional human capital that's accessible to host entity ascend by migrants' affirmative technological externalities. Paul Romer (1986, 1987, 1990) and Robert Lucas (1990) argued that migration of skilled immigrants projected as motivating the economic growth dynamics. New Growth models argued that a clear difference must be made amid skills (that are knotted to peoples) and knowledge (which isn't knotted to people).

Poot et al., (2016) has deliberated an extended version of traditional gravity model. This augmented-gravity model expands the traditional gravity model in context of international labor migration between two different economies. Additionally, it incorporates other variables except size of population, distance, economic choices, infrastructure development, and political stability in order to explain prevailed immigration patterns. In accordance to the core-principle of traditional gravity model, in context of migration is that flow of immigration between two different nations are proportionate directly with their economic size (or population growth) while proportionate inversely with distance among them. Thus, this conception is analogous of gravity's law proposed by Newton, in which strong objects asserts a great pull-effect on each-other, while the pull-effect reduces with distance (Poot et al., 2016).

In literature it is disclosed that social and economic changes (or conditions) explicates modern-areas more attractive than the rural-areas. And thus, formulates or determines the migration patterns and outflow (White, 2005). Conversely, in economics ideology, it is shown that the remittance inflow as an imperative implication or determinant of migration (Blouchoutzi, 2019). While, some researches integrates that international migration improves or advances the current-account balances of a destination economy (Gnimassoun, Simpasa, & Amusa, 2025). It is also deliberated that the cointegration between macro-economic performance indicators and migration is much stronger than the social-development.

Similarly, macro-economic performance forecasts more influence on migration than the social-development (Kwilinski et al., 2022).

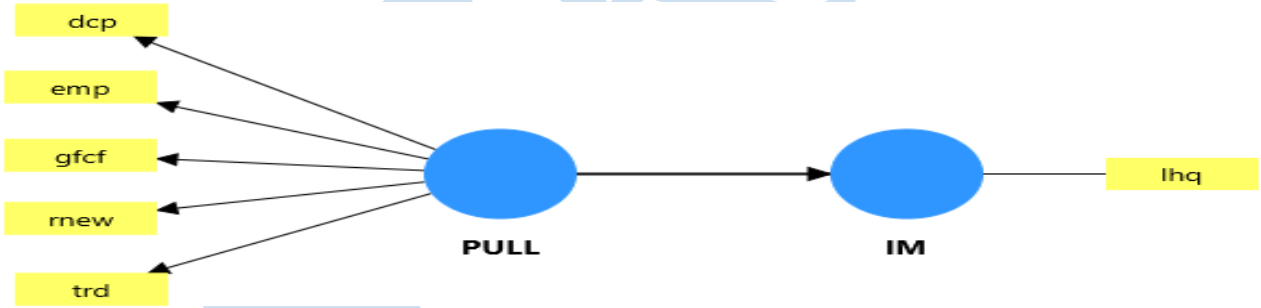
Since past few decades, the affirmative influence migration on the growth of GDP per-capita, fiscal balance, productivity, and the mitigating population-ageing has been tended to be modest. Besides, it is shown that migration along with the other forces of population-growth, can aggravate pressure on the housing-indusrty of New Zealand as it insufficiently responsive towards increased demand of houses (due to migration). This will lead transfer of national savings from productive means to other means which in turn aggravates negative macro-economic influences on the growth of the economy. Therefore it is required that migration policies must be formulated by considering the increased population absorption capacity of the economy. This will also facilitates in removing pressure from macro-economic performance (Fry, 2014).

Empirical Methodology

For dynamic analysis, researcher has decoupled the examined dynamic macro-economic pull forces modeling, in context of skilled-based international migration. Precisely, these frameworks targets to capture the influence of dynamic pull forces on aggregate migration as well as on international migration categories (type I, II, III, IV, V, VI, VII). These models emphasizes the contribution of different indicators of dynamic convergence in determining direction (either push or pull) of international migration in Pakistan;

$LHQ_t = f(GDPP_t, EMP_t, DCP_t, TRD_t, RNEW_t, X_t)$.....eq(5.1)

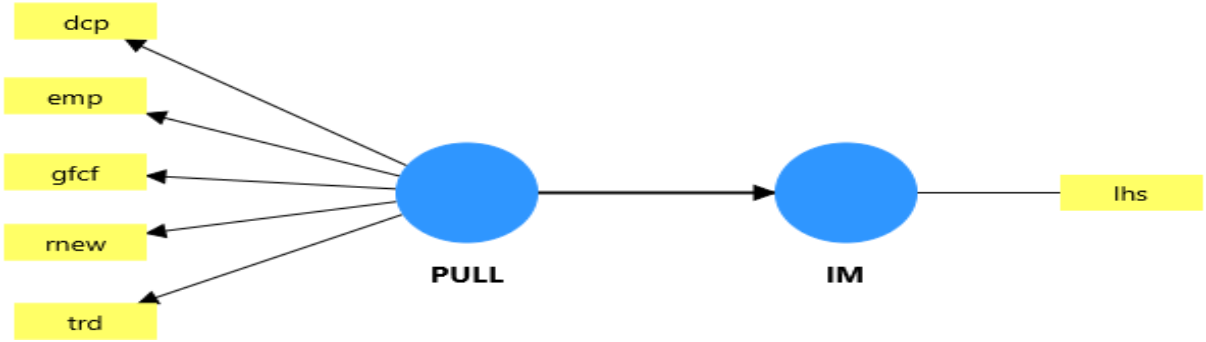
Figure 1: LHQ Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

$LHS_t = f(GDPP_t, EMP_t, DCP_t, TRD_t, RNEW_t, X_t)$.....eq(5.2)

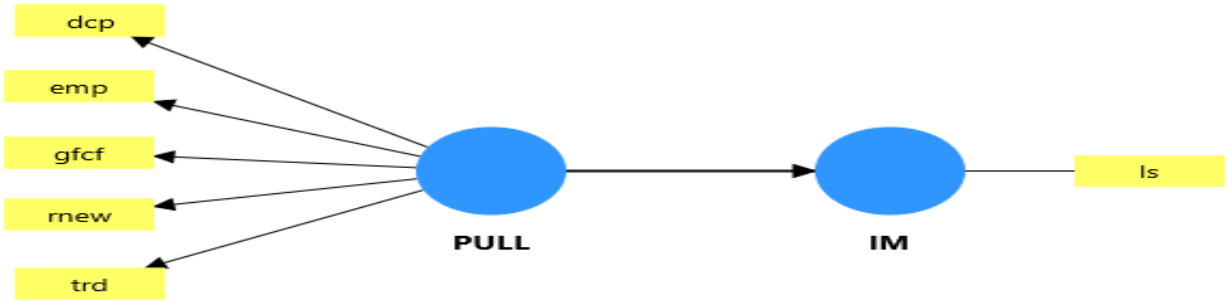
Figure 2: LHS Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

$LS_t = f(GDPP_t, EMP_t, DCP_t, TRD_t, RNEW_t, X_t)$.....eq(5.3)

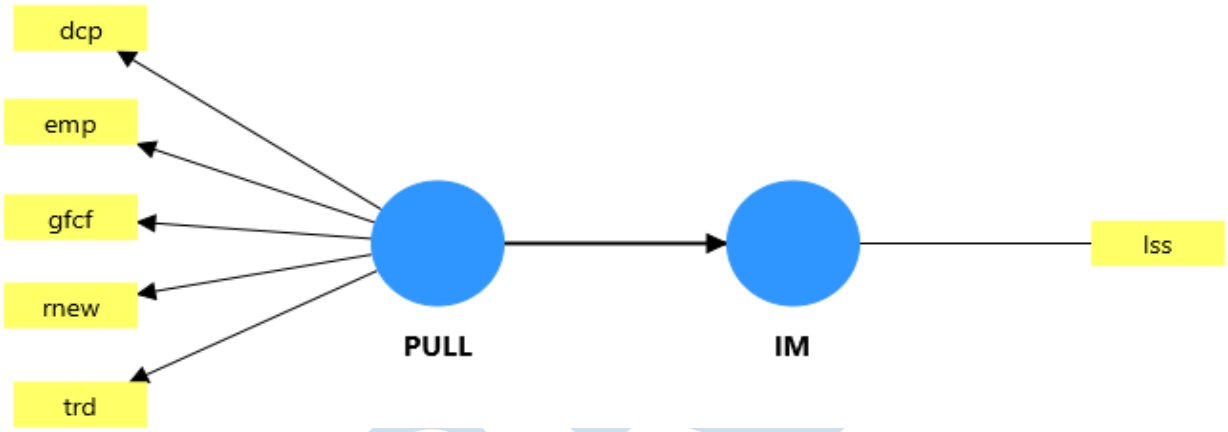
Figure 3: LS Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

$LSS_t = f(GDPP_t, EMP_t, DCP_t, TRD_t, RNEW_t, X_t)$.....eq(5.4)

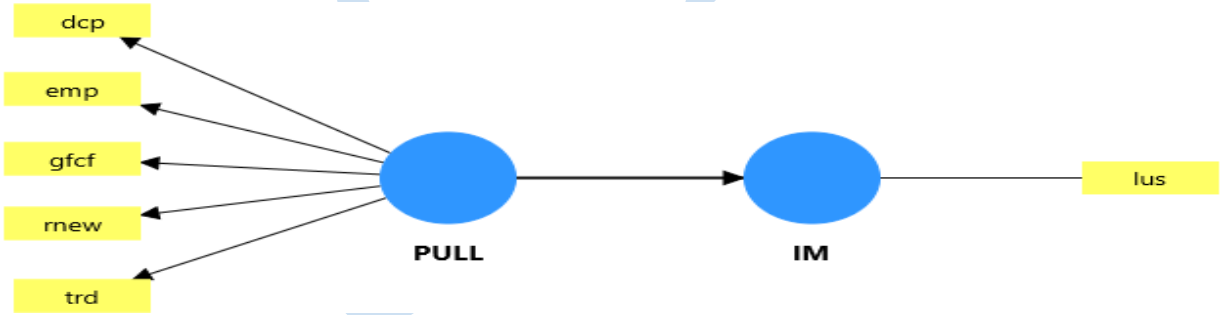
Figure 4: LSS Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

$LUS_t = f(GDPP_t, EMP_t, DCP_t, TRD_t, RNEW_t, X_t)$.....eq(5.5)

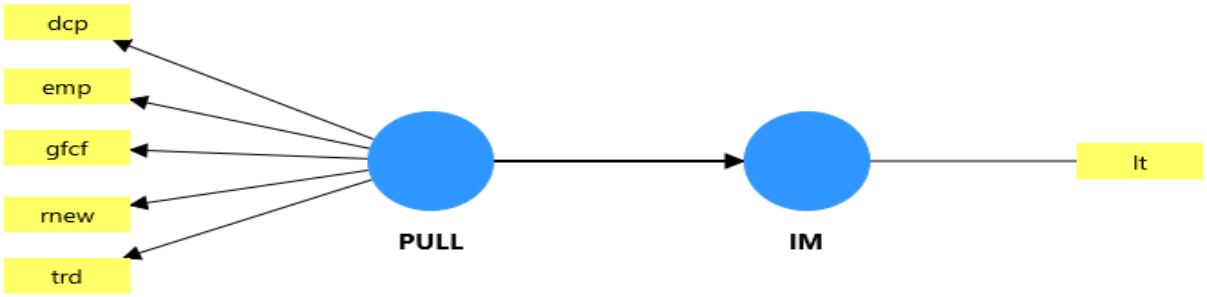
Figure 5: LUS Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

$LT_t = f(GDPP_t, EMP_t, DCP_t, TRD_t, RNEW_t, X_t)$.....eq(5.6)

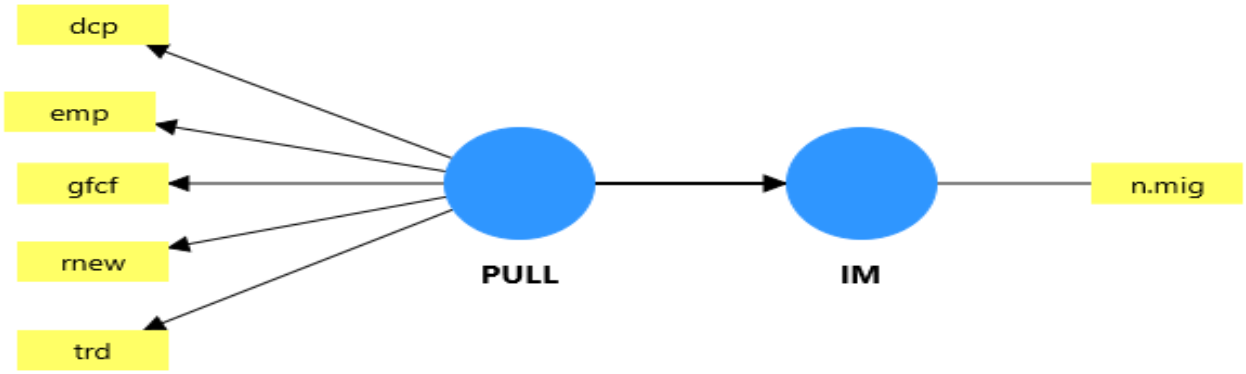
Figure 6: LT Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

$N.Mig_t = f(GDPP_t, EMP_t, DCP_t, TRD_t, RNEW_t, X_t)$.....eq(5.7)

Figure 7: N.Mig Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

Here, abbreviations used in above models postulates;
GDPP = GDP per Capita Growth
EMP = employment
DCP = Domestic credit to private sector
TRD = trade
RNEW= Renewable Energy Consumption
LHQ = Log of Highly-Qualified Labor mobility (type-I migration)
LHS = Log of highly-skilled labor mobility (type-II migration)
LS = Log of skilled labor mobility (type-III migration)
LSS = log of semi-skilled labor mobility (type-IV migration)
LUS = Log of Un-skilled labor mobility (type-V migration)
LT = Log of Total international labor mobility (type-VI migration)
N.Mig = Net Migration flow (type-VII migration)
X = Control Variables (namely, remittance and globalization)
t = time series 1976-2025

Statistical Analysis & Results

This section has been introduced for the statistical examination of collected data set. It incorporates multiple statistical analysis approaches in order to validate the empirical estimations of the concerned phenomenon.

Table 1: *Descriptive Analysis*

Indicators	Variable	Obs.	Mean	Std. Dev.	Min	Max
Knowledge Diaspora	LHQ	50	8.25	1.19	6.57	12.60
	LHS	50	9.11	0.90	7.33	13.18
	LS	50	11.46	0.98	9.62	15.59
	LSS	50	9.02	1.68	6.67	14.08
	LUS	50	11.45	1.00	10.06	15.62
	LT	50	12.29	1.01	10.63	16.46
	N.MIG	50	-42	1.05	-22	10
Pull-Driver	GDPP	50	1.94	1.98	-3.03	5.80
	GFCF	50	3.51	6.78	-14.90	19.16
	EMP	50	51.63	1.57	49.27	54.94
	DCP	50	20.72	4.72	11.97	29.78
	TRD	50	31.06	4.22	21.45	38.49
	RNEW	50	47.80	4.54	40.53	58.1
Mediating Forces	REM	50	5.22	2.31	1.08	10.24
	KOFG	50	45.10	8.31	32.44	54.75

Source: *Analyzer Creation Using Stata*

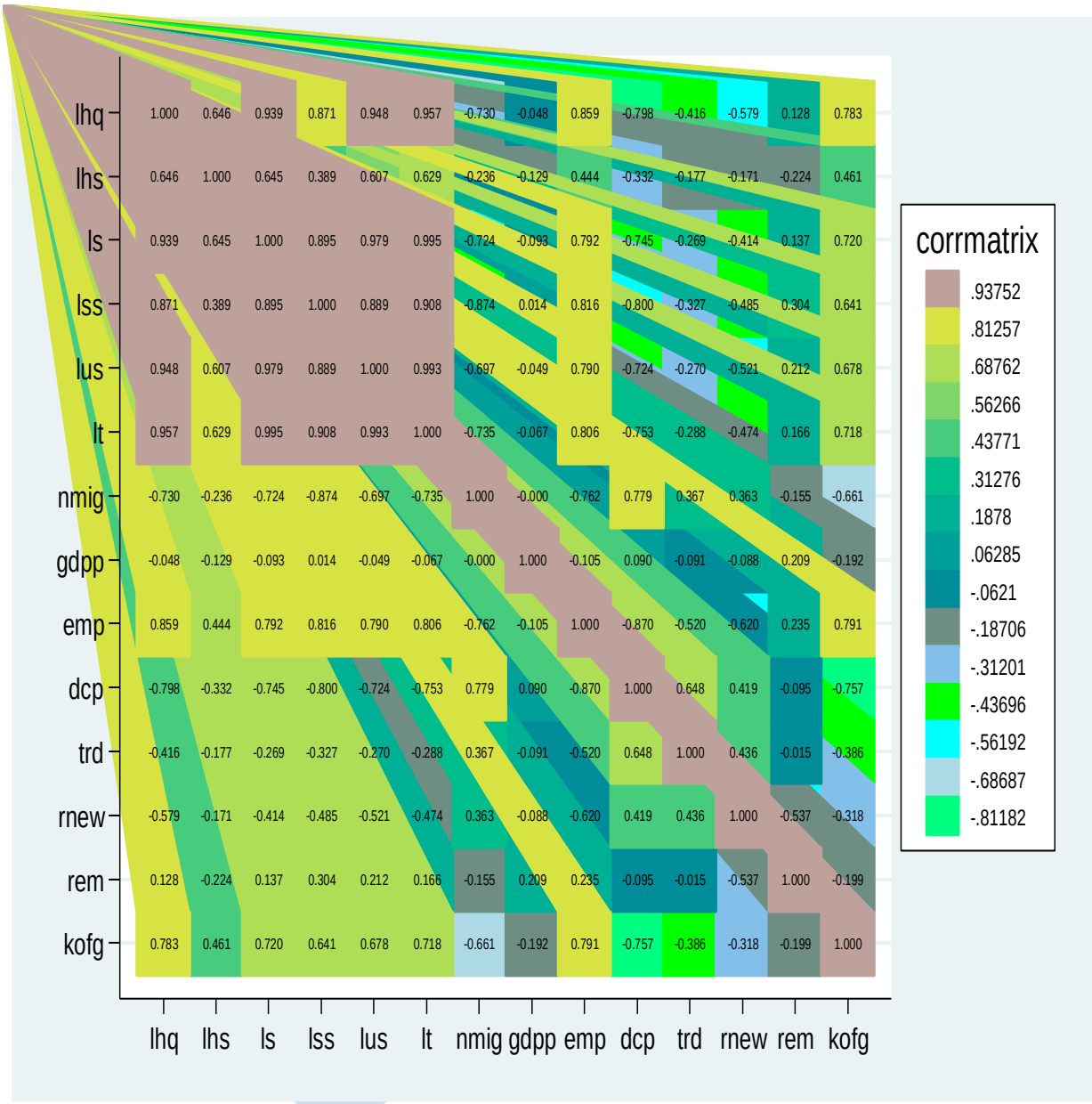
With the help of the Descriptive Analysis researcher aims to examine the demographic characteristics or the summary obtained from huge data set. The large set of data is quite tedious to read, therefore thru descriptive statistics the salient features of the examined research data are portraited. As the table explains all examined variables and their total observations in numbers (which is 50-years for this study). Besides, mean or the average value also displayed here, which shows average data tendencies. In addition, the data range has been deliberated thru max and minimum values of the data-series. Besides, standard deviation explains the variation or data deviation for each individual construct of this study.

Table 2: *Correlation Matrix*

VAR.	LHQ	LHS	LS	LSS	LUS	LT	NMIG	GDPP	GFCF	EMP	DCP	TRD	RNEW	REM	KOFG
LHQ	**1**														
LHS	0.64	**1**													
LS	0.93	0.64	**1**												
LSS	0.87	0.38	0.89	**1**											
LUS	0.94	0.60	0.97	0.88	**1**										
LT	0.95	0.62	0.99	0.90	0.99	**1**									
N.MIG	-0.73	-0.23	-0.72	-0.87	-0.69	-0.73	**1**								
GDPP	-0.04	-0.12	-0.09	0.01	-0.04	-0.06	-0.00	**1**							
GFCF	-0.19	-0.16	-0.24	-0.17	-0.21	-0.22	0.11	0.63	**1**						
EMP	0.85	0.44	0.79	0.81	0.79	0.80	-0.76	-0.10	-0.27	**1**					
DCP	-0.79	-0.33	-0.74	-0.79	-0.72	-0.75	0.77	0.09	0.22	-0.87	**1**				
TRD	-0.41	-0.17	-0.26	-0.32	-0.27	-0.28	0.36	-0.09	-0.05	-0.51	0.64	**1**			
RNEW	-0.57	-0.17	-0.41	-0.48	-0.52	-0.47	0.36	-0.08	0.04	-0.61	0.41	0.43	**1**		
REM	0.17	0.22	0.13	0.30	0.21	0.16	-0.15	0.20	-0.03	0.23	0.09	-0.01	-0.53	**1**	
KOFG	0.78	0.45	0.71	0.64	0.67	0.71	-0.66	-0.19	-0.26	0.79	-0.75	-0.39	-0.31	-0.20	**1**

Source: Analyzer Creation Using Stata

Figure 8: Correlation Heatplot



Source: *Analyzer Creation Using Stata*

The preceding figure 6.1 and table 6.2 illustrates the correlation heatplot and matrix of the examined variables of this research. There exist a strong correlation between all examined variables of the study. And the correlation is not that high to lead towards multicollinearity. Besides, each variable causes positive effect as well as negative effect on the other variables of the study. Yet, all of them, correlates 100-percent with themselves as displays by "1". The value close to one shows high correlation, while a value close to one shows weak coordination between examined variables of the study.

Table 3: *Unit Root Test*

Indicators	Variable	Z(t)	Mackinnon p-value	Significance Level	Decision
Knowledge Diaspora	LHQ	-3.73	0.04	5%	Reject (H_0)
	LHS	-3.17	0.09	10%	Reject (H_0)
	LS	-3.51	0.05	5%	Reject (H_0)
	LSS	-3.72	0.04	5%	Reject (H_0)
	LUS	-3.19	0.09	10%	Reject (H_0)
	LT	-3.65	0.04	5%	Reject (H_0)
	N.MIG	-3.61	0.04	5%	Reject (H_0)
Pull-Driver	GDPP	-5.83	0.00	1%	Reject (H_0)
	GFCF	-5.29	0.00	1%	Reject (H_0)
	EMP	-3.80	0.02	5%	Reject (H_0)
	DCP	-3.27	0.08	10%	Reject (H_0)
	TRD	-3.79	0.03	5%	Reject (H_0)
	RNEW	-4.14	0.00	1%	Reject (H_0)
Mediating Forces	REM	-4.68	0.00	1%	Reject (H_0)
	KOFG	-3.22	0.09	10%	Reject (H_0)

Source: *Analyzer Creation Using Stata*

This table 6.3, shows the unit root test, or the stationary test for the all examined research variables. This research applies "Augumented-Dickey-Fuller" (ADF) analysis approach. The followed statistical criteria for significance checking is Mackinnon. As shown with the above results, all examined variables of this research are statistically significant. Although their significance level varies, ranging between 1-10% significance level. All variables are stationary at level, stating that there is no trend in our examined data-series. And also permits the application of regression analysis, as all variables are stationary at level (I_0).

Table 4: *Regression-Bootstrapping Pull-Models Estimates*

variables	LHQ	LHS	LS	LSS	LUS	LT	N.Mig
DCP	-0.52*** (0.08)	0.40 (0.13)	-0.52* (0.01)	-0.73 (0.00)	-0.57* (0.00)	-0.47** (0.02)	0.64* (0.00)
EMP	0.49* (0.00)	0.78* (0.01)	0.49** (0.02)	0.03 (0.63)	0.36*** (0.09)	0.39*** (0.06)	-0.18* (0.43)
GDPP	-0.22* (0.00)	-0.08 (0.71)	0.03 (0.67)	-0.23*** (0.08)	0.05 (0.55)	0.26 (0.15)	-0.44* (0.00)
RNEW	-0.33* (0.00)	-0.43** (0.04)	-0.03 (0.78)	0.62* (0.00)	-0.22*** (0.06)	0.04 (0.77)	-0.31** (0.03)
TRD	0.25 (0.75)	-0.62* (0.00)	0.34* (0.00)	0.39* (0.00)	0.39* (0.00)	0.32* (0.00)	-0.27** (0.03)
Intercept	0.00 (0.23)	0.00 (0.89)	0.00 (0.58)	0.00** (0.02)	0.00 (0.87)	0.00 (0.66)	0.00 (0.95)
R-Square	0.81	0.41	0.75	0.82	0.74	0.77	0.72
Adjusted R-Square	0.79	0.34	0.72	0.80	0.71	0.74	0.69
Anova (F-Stat)	33.35* (0.00)	5.03* (0.00)	20.93* (0.00)	36.69* (0.00)	21.43* (0.00)	24.27* (0.00)	18.52* (0.00)

Note: *'*', '**', '***' shows indicator significance at 1, 5, & 10%, respectively.*

Source: *Analyzer Creation Using Smart-PLS-4*

The following table displays the regression bootstrapping pull models of this research. In the regression bootstrapping estimation, standardized coefficient and standard erros has been utilized. As it provides more robust estimates than the un-standarized estimation. As the above statistics shows that all selected pull-drivers significantly forecast an effect on international migration of Highly-qualified labor (LHQ). Although, trade causes an insignificant effect on international migration of Highly-qualified labor migration.

In contrast for the case of LHS, employment rate (EMP), renewable energy consumption (RNEW) and trade (TRD) significantly pull-out the LHS migration rate while GDP per-capita growth (GDPP) and credit providence to domestic-investors (DCP) asserts insignificant pull-effect on LHS migration rate. Similarly, for the case of LS, domestic credit for private investors (DCP), employment, and trade significantly pushes the LS migration rate while GDP per-capita growth and renewable energy consumption asserts insignificant pull-effect on LS migration rate.

Besides, in case of LSS all examined pull-constructs (except DCP and EMP) significantly pull-out LSS migration rate in Pakistan. Although, for LUS examination, except GDPP all examined construct s significantly constitutes the pull-effect in Pakistan. In contrast, for the case of LT, employment, DCP, and trade significantly pushes the LHS migration rate while GDPP and RNEW asserts insignificant pull-effect on LT migration rate. The estimates of LT provokes the significance of dis-aggregate analysis, as aggregate analysis not clearly explicates each construct s validity and contribution for different types of migrants in Pakistan. In addition, the net migration rate shows that all variables significantly contributes the net international

migration in Pakistan. The overall significance of these models is emphasized by R-square, adjusted R-square, and Anova statistics.

Table 5: *Path Models (Inner Models)*

Constructs	LHQ	LHS	LS	LSS	LUS	LT	N.Mig
DCP <- PULL	0.90	0.83	0.96	0.98	0.91	0.94	1.03
EMP <- PULL	-0.97	-1.11	-1.02	-1.00	-0.99	-1.01	-1.00
GFCF <- PULL	0.22	0.41	0.31	0.21	0.26	0.28	0.15
RNEW <- PULL	0.66	0.42	0.53	0.59	0.65	0.59	0.48
TRD <- PULL	0.47	0.44	0.34	0.40	0.34	0.36	0.48

Source: *Analyzer Creation Using Smart-PLS-4*

In the above-mentioned table, factor loadings obtained from consistent PLS-SEM (Partial Least-Square and Structural-equation modeling) has been deliberated. This tables, basically initializes the inner model construction or the path construction. It shows that the examined construct s of an indicator are statistically an imminent contributor of a construct or not?. This requires that each construct must have a factor loading above 0.50, a high factor loading indicates that examined construct is a static contributor of the indicator.

As in the above table, dynamic pull-construct s of macroeconomic performance has been demonstrated. For LHQ migrants, GFCF and trade are insignificant and non-static pull-constructs while GDPP, DCP, and RNEW are introduced as a static and significant pull-construct of LHQ migrants. Similarly, for LHS migrants, GFCF, RNEW and trade are insignificant and non-static pull-constructs while GDPP, and DCP are introduced as a static and significant pull-construct of LHS migrants.

On the contrary, for LS, LSS, and LUS migrants, GFCF and trade are insignificant and non-static pull-constructs while GDPP, DCP, and RNEW are introduced as a static and significant pull-construct. Besides, for LT, and N.Mig, GFCF and trade are insignificant and non-static pull-constructs while GDPP, DCP, and RNEW are introduced as a static and significant pull-construct.

Table 6: *Measurement Models Estimation (Outer Models)*

Total Effect	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
PULL -> LHQ	0.87	0.87	0.00	25.63	0.00
PULL -> LHS	-0.40	-0.39	0.00	3.87	0.00
PULL -> LS	0.77	0.77	0.00	19.34	0.00
PULL -> LSS	-0.81	0.80	0.00	24.34	0.00
PULL -> LUS	-0.79	-0.78	0.00	18.35	0.00
PULL -> LT	0.70	0.69	0.00	18.82	0.00
PULL -> N.Mig	0.75	0.74	0.00	17.25	0.00

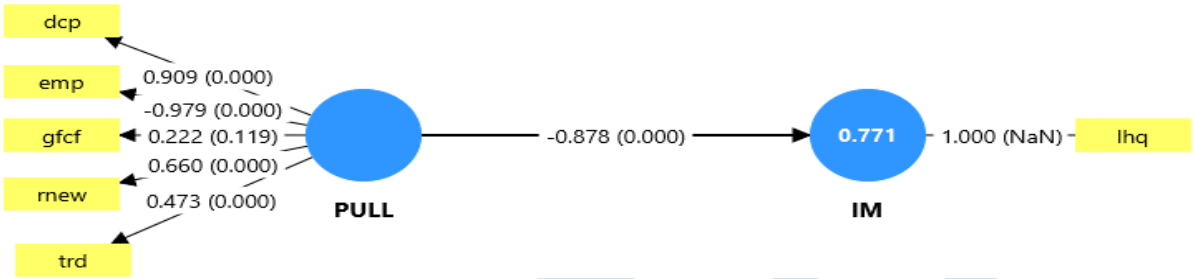
Source: *Analyzer Creation Using Smart-PLS-4*

This table explicates the total effect of dynamic pull-forces indicator in context of international migration of different categories. The total effect of pull-drivers on LHQ is 0.87 percent. This effect is statistically significant at one percent significant level. Besides, the total effect of pull-drivers on LHS is 0.40 percent This effect is statistically significant at one percent significant level. In addition, The total effect of pull-drivers on LS is 0.77 percent. This effect is

statistically significant at one percent significant level. Similarly, The total effect of pull-drivers on LSS is 0.81 percent. This effect is statistically significant at one percent significant level.

Additionally, the total effect of pull-drivers on LUS is 0.79 percent. This effect is statistically significant at one percent significant level. Conversely, the total effect of pull-drivers on LT is 0.70 percent. This effect is statistically significant at one percent significant level. In the end, the total effect of pull-drivers on N.Mig is 0.75 percent. This effect is statistically significant at one percent significant level. Based on this we can conclude that pull-indicator significantly forecast strong association with all kinds of international migration thus integrates dynamic convergence in Pakistan.

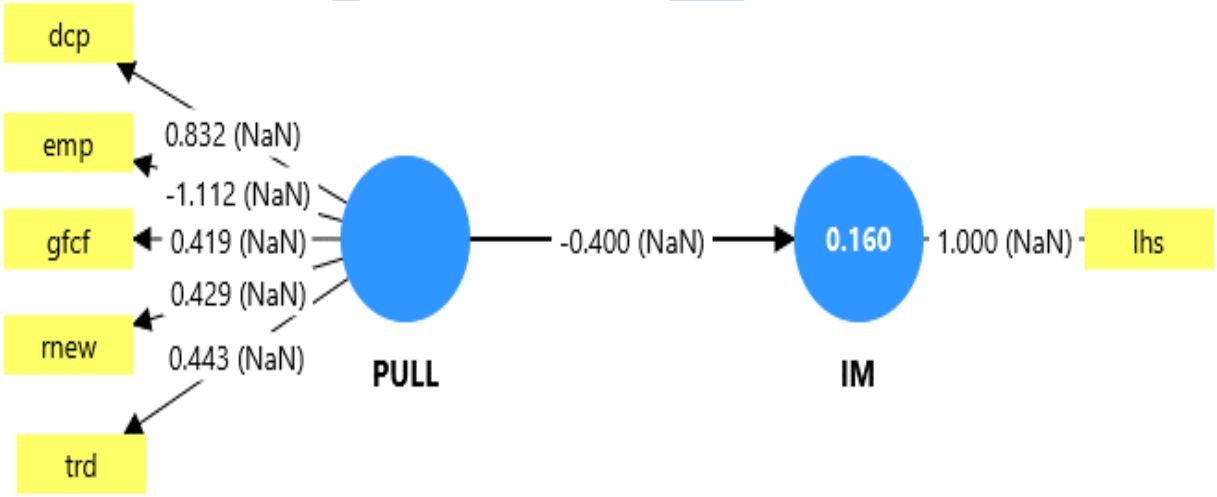
Figure 9: LHQ-Pull Measurement Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure displays the path and measurement pull-model for LHQ migrants. In this figure, the total effect and the all factor loadings are statistically significant (except GFCF), indicating models validity and statistical significance. The R-square is 0.77 indicating that this pull-model explains 77 percent variation in LHQ.

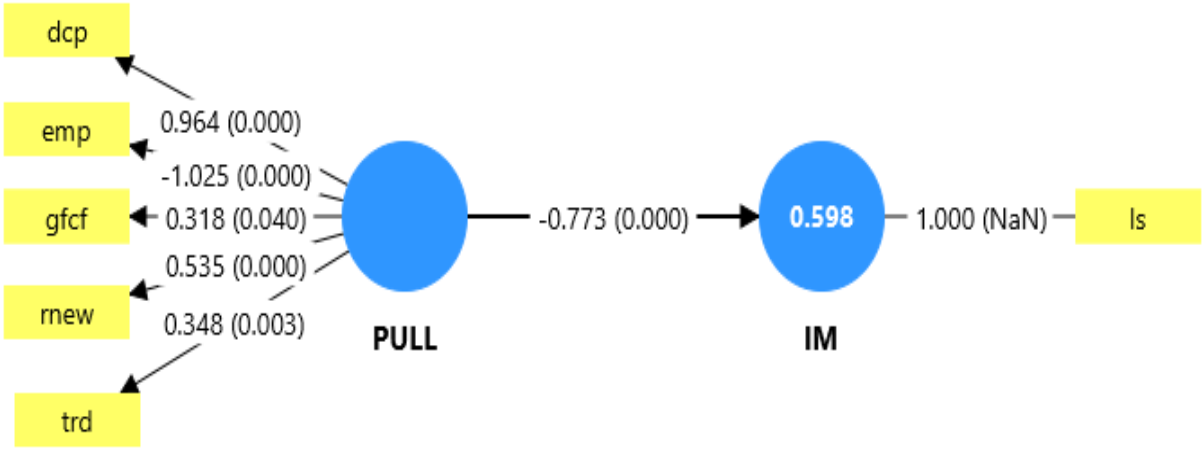
Figure 10: LHS-Pull Measurement Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure displays the path and measurement pl-model for LHS migrants. In this figure, the total effect and the all factor loadings are statistically significant (except GFCF), indicating models validity and statistical significance. The R-square is 0.16 indicating that this pull-model explains 16 percent variation in LHS.

Figure 11: LS-Pull Measurement Model



Source: *Analyzer Creation Using Smart-PLS-4*

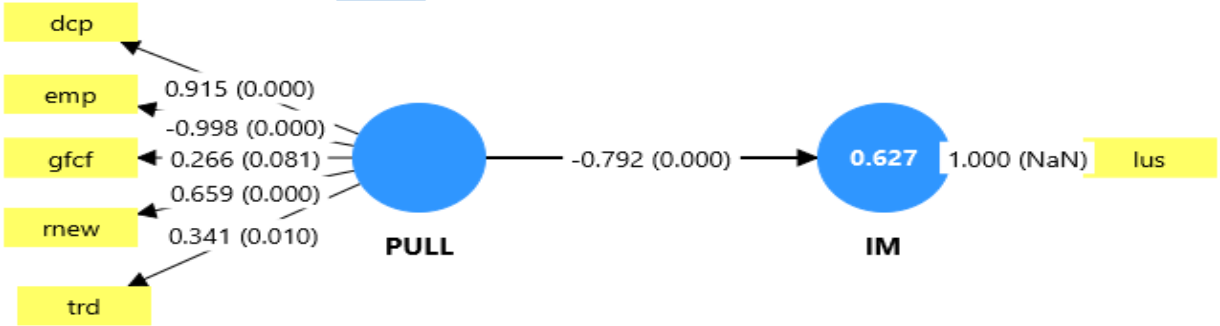
This figure displays the path and measurement pull-model for LS migrants. In this figure, the total effect and the all factor loadings are statistically significant, indicating models validity and statistical significance. The R-square is 0.59 indicating that this pull-model explains 59 percent variation in LS.

Figure 12: LSS-Pull Measurement Model

Source: *Analyzer Creation Using Smart-PLS-4*

This figure displays the path and measurement pull-model for LSS migrants. In this figure, the total effect and the all factor loadings are statistically significant (except GFCF), indicating models validity and statistical significance. The R-square is 0.66 indicating that this pull-model explains 66 percent variation in LSS.

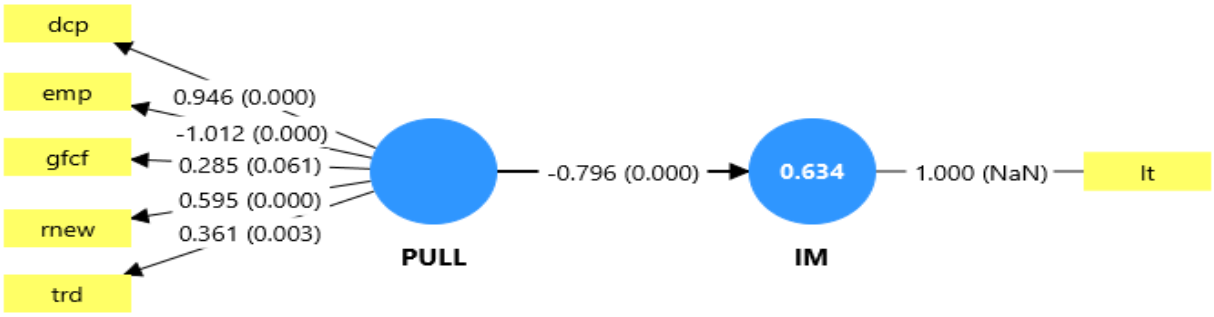
Figure 13: LUS-Pull Measurement Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figures displays the path and measurement pull-model for LUS migrants. In this figure, the total effect and the all factor loadings are statistically significant indicating models validity and statistical significance. The R-square is 0.62 indicating that this pull-model explains 62 percent variation in LUS.

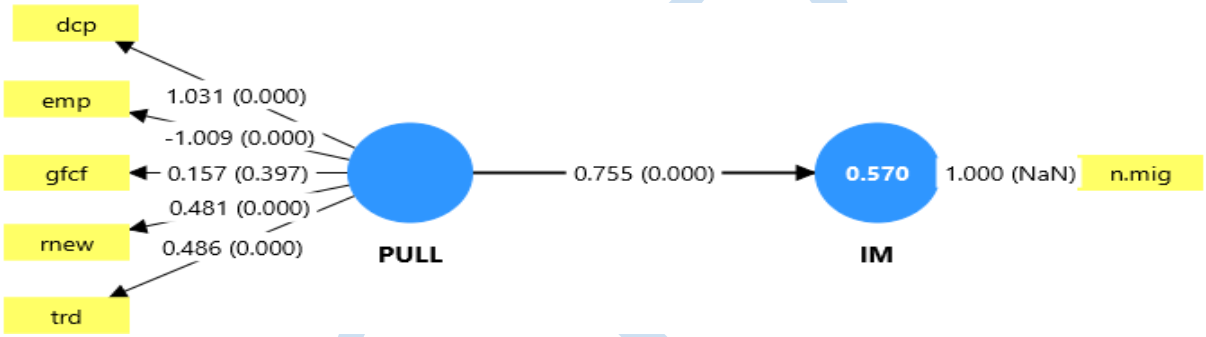
Figure 14: LT-Pull Measurement Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figures displays the path and measurement pull-model for LT migrants. In this figure, the total effect and the all factor loadings are statistically significant indicating models validity and statistical significance. The R-square is 0.63 indicating that this pull-model explains 63 percent variation in LT.

Figure 15: N.Mig-Pull Measurement Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figures displays the path and measurement pull-model for N.Mig migrants. In this figure, the total effect and the all factor loadings are statistically significant (except GFCF), indicating models validity and statistical significance. The R-square is 0.57 indicating that this push-model explains 57 percent variation in N.Mig.

Table 7: *Constructs Reliability & Validity*

Total Effect	Cronbach's Alpha	Rho-A	Rho-C	AVE (Average Variance Extracted)
PULL -> LHQ	-0.86	0.90	0.79	0.59
PULL -> LHS	-0.86	0.94	0.78	0.59
PULL -> LS	-0.86	0.93	0.74	0.59
PULL -> LSS	-0.86	0.93	0.76	0.50
PULL -> LUS	-0.86	0.91	0.75	0.59
PULL -> LT	0.86	0.92	0.75	0.59
PULL -> N.Mig	0.86	0.95	0.75	0.51

Source: *Analyzer Creation Using Smart-PLS-4*

In order to examine the internal model validity and reliability different estimation techniques has been employed here namely Crohnbach's Alpha, composite reliability (Rho-C), and coefficient of convergent (Rho-A), along with average-extracted-variance. The difference between Rho-A and Rho-C is that Rho-A is a modern method than Rho-C as it's less-senstive

in regards with number of used construct s. Based on obtained estimates, the Crohnbach's Alpha is greater than 0.7 showing that each construct is an important representer of their construct . Besides, the Rho-A and Rho-C are also greater than 0.7 indicating path models reliability and validity, for all examined models. Conversely, for the case of all dynamic pull-construct s models, the AVE is greater than 0.5 which signifies that used construct s evaluates a considerate variance portion of the given indicators.

Table 8: *External Validity & Reliability*

Total Effect	HTMT Ratio
PULL -> LHQ	0.88
PULL -> LHS	0.70
PULL -> LS	0.76
PULL -> LSS	0.81
PULL -> LUS	0.78
PULL -> LT	0.79
PULL -> N.Mig	0.74

Source: *Analyzer Creation Using Smart-PLS-4*

In order to explicate the external model validity and reliability HTMT-discriminant ratio has been employed as an estimation technique, for this research. This is a more sensitive, and highly-nuanced estimation method for evaluating external validity of indicators. A higher HTMT-ratio is alarming, researchers has limited it up to 0.90, while a low HTMT value represents that construct s are distinct measure of their indicator. As for all examined dynamic pull-drivers the HTMT ratio is quite less than critical value (0.9) therefore, we can confirm that all examined models are externally valid and distinct.

Table 10: *Models Fitness Statistics*

Model Fitness	F-Square	R-Square	Adjusted R-Square	SRMR	d_ULS
PULL -> LHQ	3.35 (0.00)	0.77	0.76	0.08	0.13
PULL -> LHS	1.19 (0.00)	0.16	0.14	0.07	0.29
PULL -> LS	1.48 (0.00)	0.59	0.59	0.07	0.26
PULL -> LSS	1.94 (0.00)	0.66	0.65	0.08	0.18
PULL -> LUS	1.67 (0.00)	0.62	0.61	0.07	0.26
PULL -> LT	1.73 (0.00)	0.63	0.62	0.08	0.23
PULL -> N.Mig	1.32 (0.00)	0.57	0.56	0.08	0.15

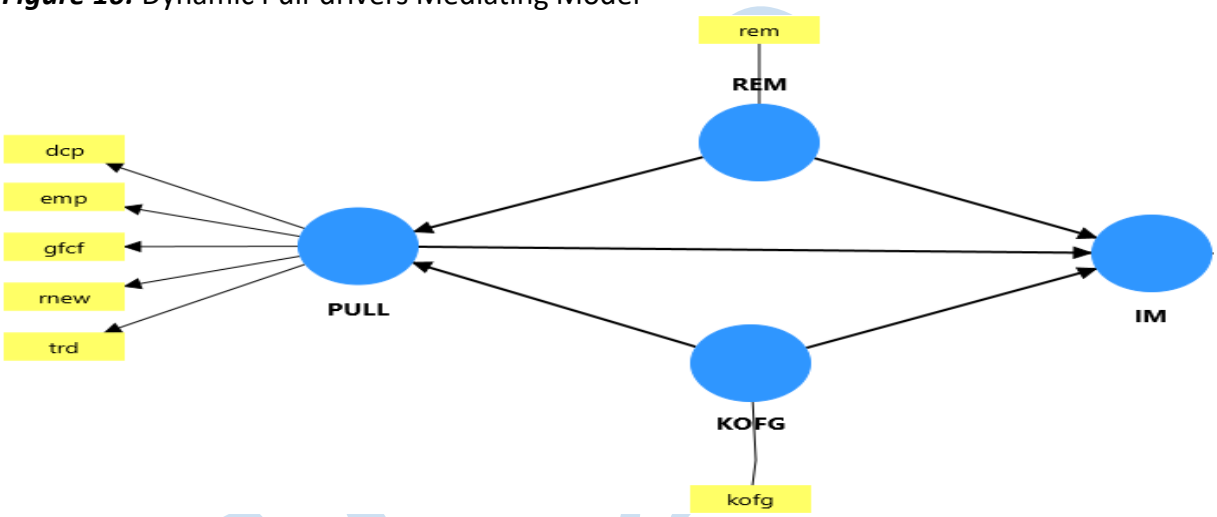
Note: *In '()', p-values are integrated*

Source: *Analyzer Creation Using Smart-PLS-4*

In order to demonstrate the overall significance and model fitness, following displayed table has been originated. In order to examine the internal model fitness and overall significance different estimation techniques has been employed here namely R-square, adjusted R-square, F-statistics, D-ULS, and SRMR techniques. All these techniques highlights the model fitness and the overall significance of the examined models. For the case of all examined dynamic pull-indicator estimation, F-statistics is statistically significant indicating overall model significance and acceptance. Similarly, R-square and adjusted R-square explicates the portion of variation explained by examined pull-construct s which is also static for all examined models of the research. Besides, SRMR value is less than the critical value (0.09) highlighting considered models significance.A low D-ULS indicates that all examined models adequately explains the association between examined variables of the study.

Mediating Contribution of Remittance-Inflows and Globalization

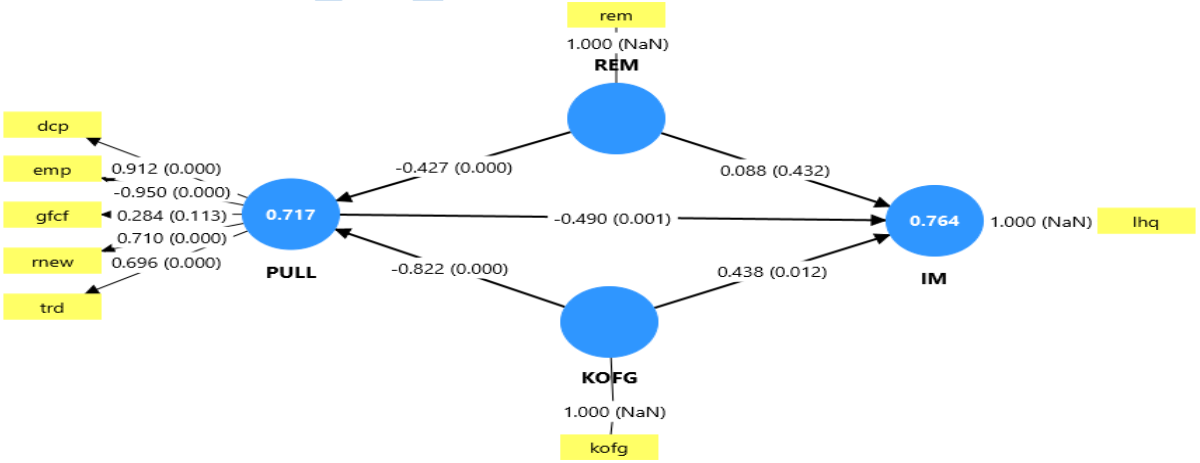
Figure 16: Dynamic Pull-drivers Mediating Model



Source: *Analyzer Creation Using Smart-PLS-4*

In the above given illustrations, mediating effect of globalization and remittance-inflows has been checked on the cointegration of international migration and the macro-economic performance. As the pull-drivers has been classified into five distinct construct s therefore, above figure illustrates pull models classification for this research.

Figure 17: Mediating Effect LHQ-Pull Model

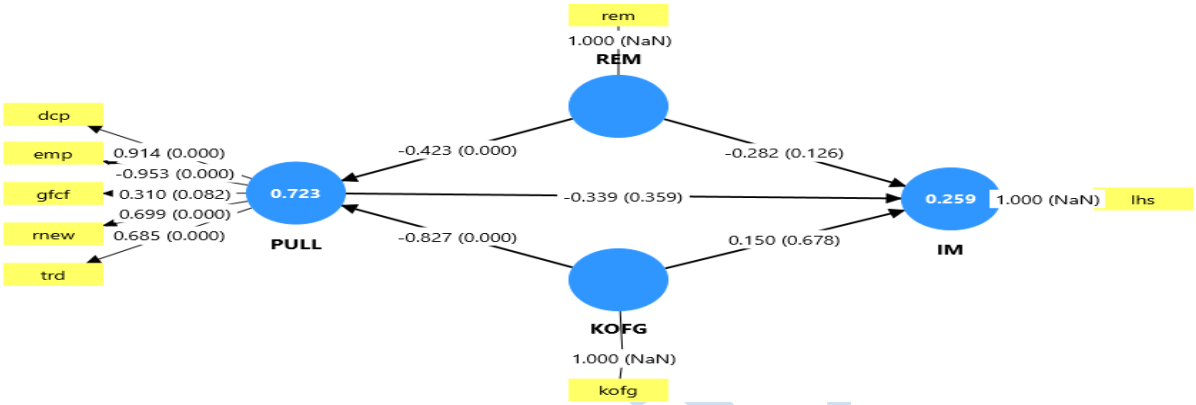


Source: *Analyzer Creation Using Smart-PLS-4*

This figure highlights the mediating effect of remittance and globalization on the Highly-qualified international migration (LHQ) of and the macroeconomic pull-indicator.

Globalization significantly mediates pull-indicator as well as net migration rate. Although, remittance only mediates pull-indicator. Remittance inflows forecasts an income stabilizing effect while globalization thru its multiple operating channels (such as trade, current account balance) influences international migration as well as macroeconomic performance (Stancu, & Popescu, 2018; Lupoiu & Raceanu, 2019; and Vincent, 2022).

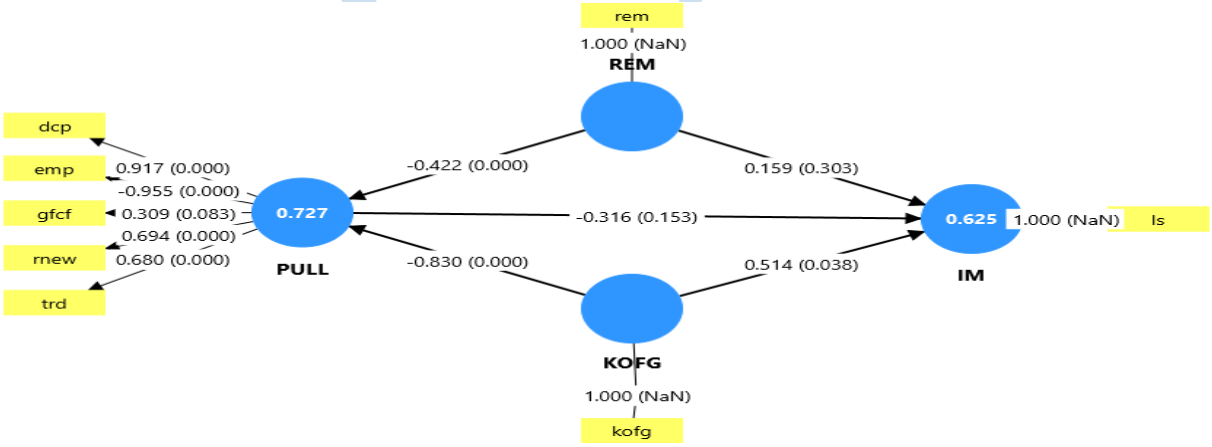
Figure 18: Mediating Effect LHS-Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure highlights the mediating effect of remittance and globalization on the total international migration (LHS) of and the macroeconomic pull-indicator. Globalization significantly mediates pull-indicator as well as net migration rate. Although, remittance only mediates pull-indicator. Remittance inflows forecasts an income stabilizing effect while globalization thru its multiple operating channels (such as trade, current account balance) influences international migration as well as macroeconomic performance (Stancu, & Popescu, 2018; Lupoiu & Raceanu, 2019; and Vincent, 2022).

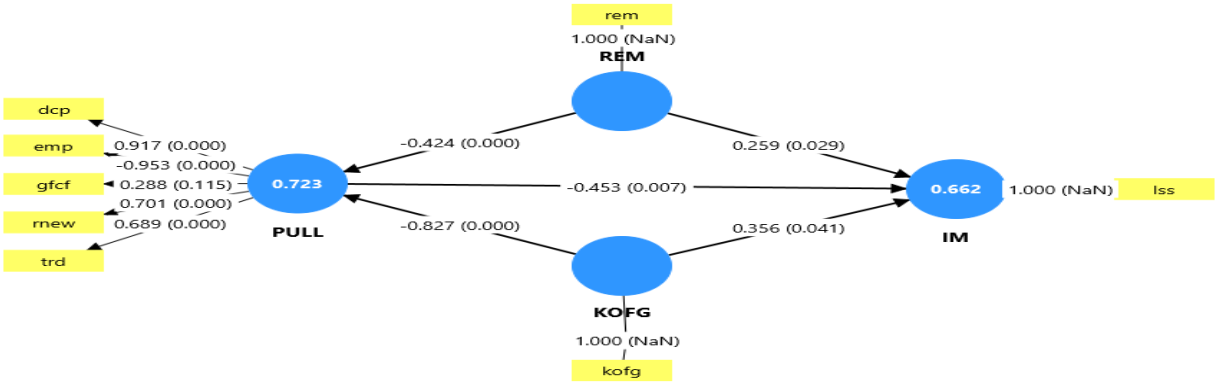
Figure 19: Mediating Effect LS-Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure highlights the mediating effect of remittance and globalization on the skilled international migration (LS) of and the macroeconomic pull-indicator. Globalization significantly mediates pull-indicator as well as net migration rate. Although, remittance only mediates pull-indicator. Remittance inflows forecasts an income stabilizing effect while globalization thru its multiple operating channels (such as trade, current account balance) influences international migration as well as macroeconomic performance (Stancu, & Popescu, 2018; Lupoiu & Raceanu, 2019; and Vincent, 2022).

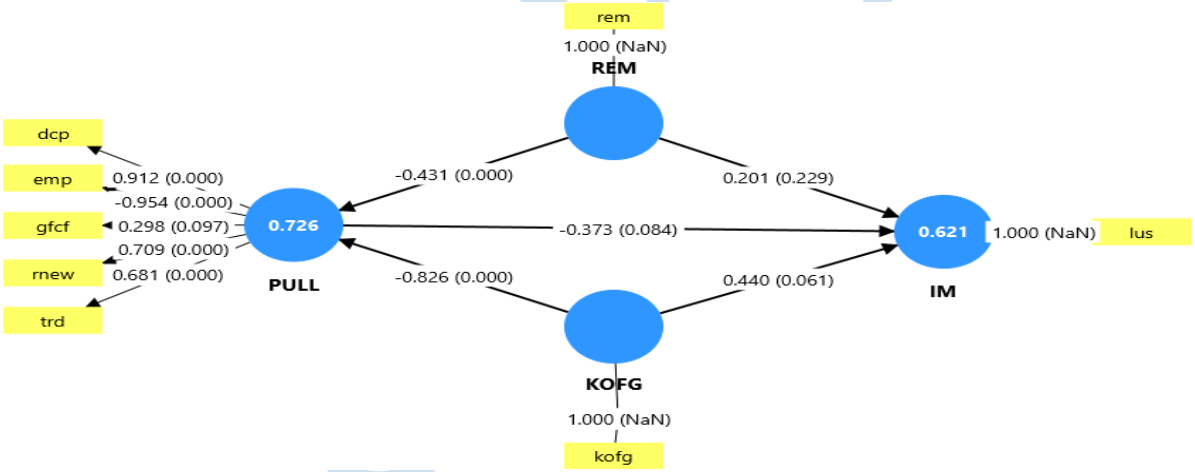
Figure 20: Mediating Effect LSS-Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure highlights the mediating effect of remittance and globalization on the total international migration (LSS) of and the macroeconomic pull-indicator. Globalization significantly mediates pull-indicator as well as net migration rate. Although, remittance also mediates pull-indicator and international migration. Remittance inflows forecasts an income stabilizing effect while globalization thru its multiple operating channels (such as trade, current account balance) influences international migration as well as macroeconomic performance (Stancu, & Popescu, 2018; Lupoiu & Raceanu, 2019; and Vincent, 2022).

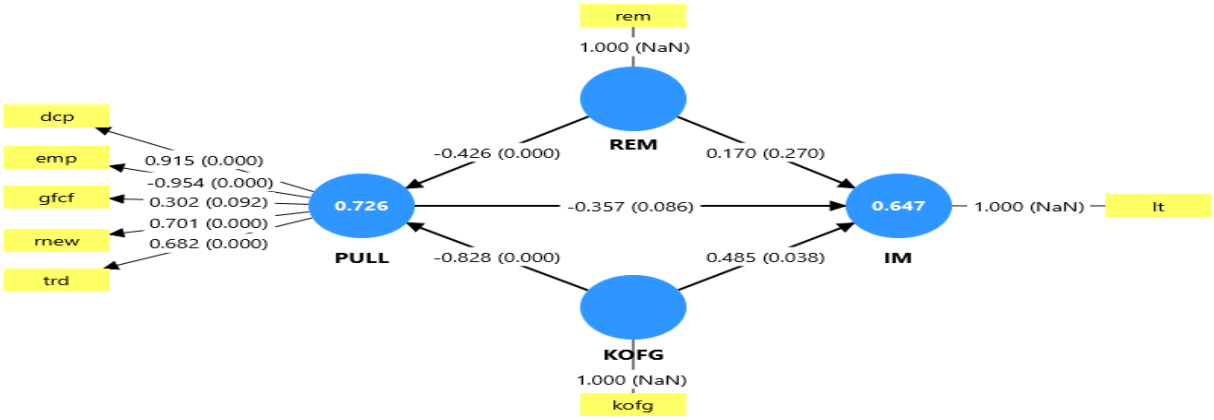
Figure 21: Mediating Effect LUS-Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure highlights the mediating effect of remittance and globalization on the total international migration (LUS) of and the macroeconomic pull-indicator. Globalization significantly mediates pull-indicator as well as net migration rate. Although, remittance only mediates pull-indicator. Remittance inflows forecasts an income stabilizing effect while globalization thru its multiple operating channels (such as trade, current account balance) influences international migration as well as macroeconomic performance (Stancu, & Popescu, 2018; Lupoiu & Raceanu, 2019; and Vincent, 2022).

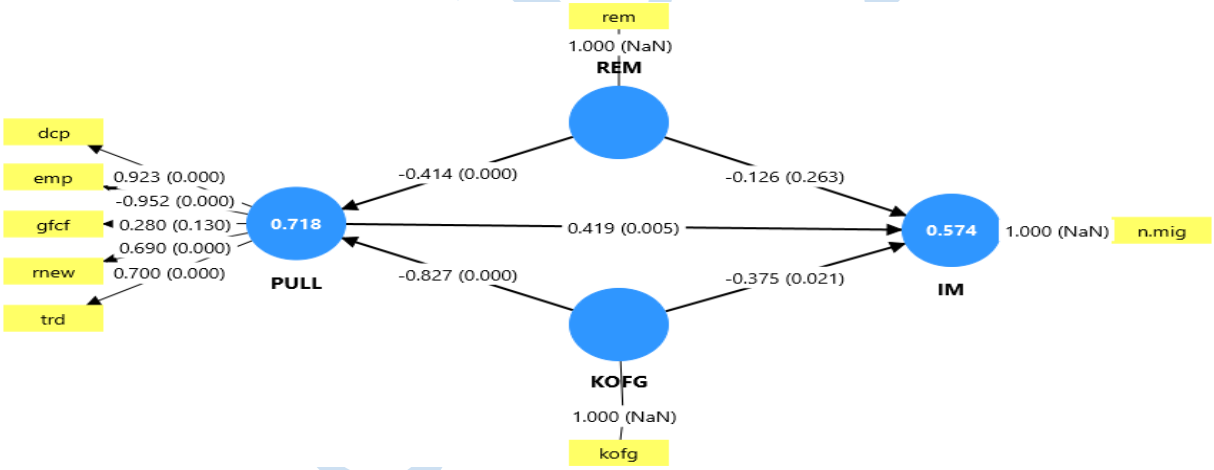
Figure 22: Mediating Effect LT-Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure highlights the mediating effect of remittance and globalization on the total international migration (LT) of and the macroeconomic pull-indicator. Globalization significantly mediates pull-indicator as well as net migration rate. Although, remittance only mediates pull-indicator. Remittance inflows forecasts an income stabilizing effect while globalization thru its multiple operating channels (such as trade, current account balance) influences international migration as well as macroeconomic performance (Stancu, & Popescu, 2018; Lupoiu & Raceanu, 2019; and Vincent, 2022).

Figure 23: Mediating Effect N.Mig-Pull Model



Source: *Analyzer Creation Using Smart-PLS-4*

This figure highlights the mediating effect of remittance and globalization on the net international migration (N.Mig) of and the macroeconomic pull-indicator. Globalization significantly mediates pull-indicator as well as net migration rate. Although, remittance only mediates pull-indicator. Remittance inflows forecasts an income stabilizing effect while globalization thru its multiple operating channels (such as trade, current account balance) influences international migration as well as macro-economic performance (Stancu, & Popescu, 2018; Lupoiu & Raceanu, 2019; and Vincent, 2022).

Conclusion

Most of the researchers has decomposed international migration into skilled categories (such as; Mehmood, 2019). Although, few of them incorporates dis-aggregate and aggregate analysis of international migration, yet these studies also fails to incorporate net migration in their aggregate analysis (Ejaz et al., 2022). Studies examining international net migration does

ignore the aspect of aggregate and disaggregate analysis (Kwilinski et al., 2021). Therefore, this research incorporates both analysis methodologies in this study.

This research entails a comprehensive deductive-methodology concerning the dynamics of international mobility and the dynamic convergence of macroeconomic performance. A time series data has been compiled over the time-span of 1976-2025. The statistical estimations encompasses unit root analysis, regression bootstrapping, consistent PLS-SEM, convergent validity, discriminant validity, and some other diagnosis approaches for time series. Additionally, factor analysis has been performed by incorporating "consistent partial-least-square & structural-equation modeling" (PLS-SEM) in order to explicate the empirical significance of each pull-construct . Conversely, the role of remittance and globalization has also been examined in mediating international migration and macro-economic performance. The obtained findings postulates that aggregate-analysis provides a complex cointegration, thus for an in-depth inside disaggregate-analysis must be considered. All examined dynamic pull drivers significantly coordinates with different skill-types of international migration. The most static influence has been captured by socio-economic stability (employment rate) and the environmental quality (renewable energy). While, financial stability has also signified its imperative contribution as shown by allocation to domestic investors (DCP) statistics. Besides, remittances empowered by dynamic constructs can significantly mediates the pull-back strength of pull-drivers. Remittance inflows asserts an income stabilizing effect on macro-economic performance, therefore, in formulating international migration policies, it must be considered. While, the globalization has also asserted an imperative mediating influence on international migration and the dynamic convergence. The concluding remarks of this study is that dynamic convergence (mainly socio-economic stability and environmental performance) significantly contributes the knowledge diaspora from Pakistan.

Policy Implications

This research proposed or suggested following recommendations for policymakers;

- The increased unemployment push-back migration outclow, therefore it must be controlled and the decent job opportunities must be provided in Pakistan for the reversal of brain-drain.
- In contrast, improvement environmental quality can assist in reverting human-capital flight. Thus, renewable energy usage must be provoked.
- With increased trade there's a down-fall in migration outflow, thus it must be provoked in Pakistan.
- Remittances incurs income -stabilizing influence which must be considered in migration studies.

Study Limitations

This research aims to evaluates the influence of macroeconomic pull forces in determining knowledge diaspora from Pakistan. Although, this research fails to incorporate some aspects which initiates the limitations of this study. These limitations are as follows:

- This research fails to explain the push forces behind the international migration. As researcher is merely focusing the pull-drivers of international migration.
- This research fails to evaluate which province (or area) contributes a major share of international migrants outflow. As this research primitively focuses overall migration trend thus fails to explain regional heterogeneity here.

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