Migration Letters

Volume: 20, No: 7, pp. 1027-1034

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)
www.migrationletters.com

Environmental Degradation, Economic Fundamentals and Migration in the Asian Region

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Abstract

Asia has many emerging economies and is a region with impressive economic growth. And labor mobility and migration have become a matter of concern in this area. However, studies on migration in this region still seem to focus heavily on economic aspects. This study will further focus on the aspect of environmental migration as a current global issue. By using the dynamic panel data of 47 Asian countries with random effect, fixed effect, and the two-step system GMM to discover the climatic factors and socio-economic factor on the international migration from 1990 to 2020 by five-year data. Our empirical findings confirm that climate change factors, including CO2 emissions, rainfall, and temperature have significantly impacted on the international migration in Asia. Furthermore, economic factors such as per capita income levels and economic growth have consistently reduced migration over the past three decades. These empirical results hold true across various sub-samples, regardless of the income level under consideration. Through these findings, this study proposes relevant policy implications which are related to environmental degradation and migration in Asia.

Keywords: *Environmental Degradation; Migration; Unemployment; Economic growth; GMM; the Asian countries.*

1. Introduction

Asia is widely recognized as a dynamic region for economic growth and development. Additionally, Asia is characterized by unpredictable weather fluctuations. The Asian economies play a crucial role in promoting regional integration, contributing to the economic growth of all member countries in the region. Labor movement within international integration in Asia has emerged as a pivotal policy concern. Environmental degradation strongly impacts human mobility and the labour market in the origin or destination countries. According to the United Nations, the estimated percentage of the world population classified as migrants was 2.8 percent in 2020. The international migrant population constituted 3.6 percent of the world's population. In 2020, Europe hosted approximately 87 million international migrants, while Asia welcomed around 86 million. These two continents combined accounted for 61 percent of the global international migrant population (IOM, 2022).

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While research theories on migration still draw their scientific foundations from the early periods of industrial revolutions, such as Ravenstein (1885), Lee (1966), the theories themselves tend to be relatively straightforward. They primarily describe and emphasize labor movement based on economic factors and the industrialization process, as exemplified by Harris-Todaro (1970). Massey et al. (1993) argue that migration is a household strategy for diversifying income streams and hedging against climate-related economic uncertainties and shocks. Besides, Black et al. (2011) describe environmental factors which have an important impact on migration in the world.

The recent papers on the relationship between climate change and migration aim to consolidate the main findings from previous studies, which remain a subject of ongoing debate. Backhaus et al. (2015) propose that an increase in temperature and precipitation in the home country is linked to a rise in migration flows to destination countries. Similarly, Nawrotzki & Bakhtsiyarava (2017) identify discernible seasonal patterns that connect climate variability with migration responses. These trends align with the growing season for temperature effects and precede the season characterized by increased precipitation impacts. Echoing these findings, Dallmann & Millock (2017) illustrate that a higher frequency of droughts in the home state positively affect with inter-state migration in India. Furthermore, Falco et al. (2018) observe that climate-induced reductions in agricultural productivity significantly contribute to increased emigration from developing nations, especially in impoverished countries. In contrast, Suckall et al. (2017) reach the conclusion that, particularly in countries like Malawi with predominantly rural economies, climate change tends to pose challenges to migration rather than increasing the overall migration rate. Similarly, Sedova and Kalkuhl (2020) provide evidence supporting the notion that adverse weather shocks have the effect of reducing both rural-rural and international migration. Instead, these conditions tend to drive people towards urban areas in different, often more economically prosperous states. La Spina (2021) focused on the migrant vulnerability in European in author's paper. Furthermore, Dudu, S., & Rojo, T. (2021) provide that migration experience has a positive effect on labour income in Turkey. On the contrary, a series of favorable weather shocks tends to stimulate both international migration and migration to cities within the same state. Additionally, their study suggests that climate migrants are more likely to come from households that heavily rely on agricultural production and are situated towards the lower end of the skill distribution. Similarly, Hasnat et al. (2022) demonstrated that agriculture and fishing practices are diminishing compared to previous years, while there is a growing inclination towards international migration. Among the six villages examined, those closest to the coast had the highest percentage of migration. Despite limited awareness of climate change terminology, most respondents exhibited a positive attitude towards changes in the frequency of climatic hazards. Furthermore, Nguyen et al., (2023) implies that we should develop long-term policies for localities where natural disasters occur, especially in areas frequently affected by natural disasters which are related in the livelihoods of people. When Huynh and Vo (2023) found that there the relationship between international migration and labor market in Asia. Heikkilä & Pehkonen (2023) results that immigrants' economic status and experiences at work have related in the migrants in Finland. Interestingly, some studies show that the impact results depend on differences over time, migration trends, or depending on the country, leading to more complex results. Piccitto & Avola (2023) found the interesting results about job satisfaction between the migrants and native people in Italia. Recent empirical research results on migration also show that many authors focus more on economic factors of migration such as income, economic growth, and trade as important factors of migration (Tombe & Zhu, 2019; Cottier & Shinghal, 2019, Tomohara, 2019; Czaika & Parsons, 2017; Macková et al., 2019; Raymer et al., 2019). Many recent studies have paid more attention to climate factors such as temperature, precipitation or environmental degradation issues such as global warming, greenhouse effect or other environmental factors affecting to international migration flows (Falco et al., 2019; Cattaneo et al., 2019;

Mueller et al., 2020; Sloat et al., 2020; AboElsoud et al., 2020; Beyer et al., 2022; Schneider, 2022; Withers et al., 2022; Minehan & Wesselbaum, 2023) but they still focus on Europe, OECD, United Nations, China, India. There seems to be no systematic focus on environmental migration in Asian countries. Our review of the existing literature highlights a gap in research concerning the connection between environmental degradation, and other economic-socio indicators on the migration. This study examines environmental, and key economic factors affecting the international migration flows in Asian countries, such as temperature, rainfall and emission dioxide (climate change factors) and GDP per capita, economic growth, trade openness and unemployment (economic fundamentals).

2. RESEARCH METHODOLOGY, DATA

This study examines the effects of climatic and socio-economic factors on migration (Mueller et al., 2020; Sedova and Kalkuhl., 2020; Minehan & Wesselbaum., 2023). We investigate the effects of environmental degradation on the migration in Asia:

$$MIG_i = \beta_0 + \beta_1 TEM_i + \beta_2 RAI_i + \beta_3 CO_{2i} + \beta_4 GROW_i + \beta_5 TRADE_i + \beta_6 UNEMP_i + \beta_7 GDP_i + u_i$$

Where: $MIGRATION_j$ denotes net international migration rate (per thousands); $CO2_i$ represents the logarithm of the CO_2 emissions ($MtCO_2$); RAI_i stands for the logarithm of rainfall (mm), TEM_i is average temperature (^0C); GDP_i denotes the logarithm of GDP per capita (USD); $UEMMPL_i$ represents the unemployment rate (percent); $TRADE_i$ stands for the trade openness measured as the sum of a country's exports and imports as a share of the GDP (percent); $GROW_i$ denotes the economic growth (percent) which are collected by United Nations, World Bank, Our World in Data, and International Labour Organisation. This paper collected the 47 countries' data with the 5-year estimates because of the limitation of migration data from the United Nation. Furthermore, the data is not including Taiwan, Hong Kong, Macao, and Palestine because of the lack of these countries' figures.

Temperature and rainfall have found extensive application in empirical migration studies at the macro-level. For instance, Backhaus et al. (2015), Mueller et al. (2020), and Sedova & Kalkuhl (2020) employed temperature as a variable to explore the connection between migration and climate change. On the other hand, Thiede et al. (2016), Dallmann & Millock (2017), and Mueller et al. (2020) utilized rainfall to assess its influence on migration. Additionally, Backhaus et al. (2015) and Marchiori et al. (2015) propose that an increase in temperature and precipitation in a sending country correlates with higher migration flows to the respective destination country. Furthermore, Rafiq et al. (2016) conducted an investigation into the impact of pollutant emissions in a panel comprising countries with varying income levels. The results indicate that multi-collinearity is not a significant issue in our analysis. Furthermore, the autocorrelation test tests the null hypothesis that there is no autocorrelation in the residuals of your model. In this study, the authors utilized the Breusch-Pagan/Cook-Weisberg test to test for the presence of heteroscedasticity, where the null hypothesis (H0) is homoscedasticity (residuals are distributed with equal variance), and the alternative hypothesis (HA) is heteroscedasticity (residuals are not distributed with equal variance). The p-value of the test (Prob > chi2 = 0.0000) was less than the chosen significance level, leading to the rejection of the null hypothesis and concluding that heteroscedasticity is present in the regression model. According to Wooldridge (2001), the GMM estimation technique becomes more suitable when the number of countries exceed the study's time periods (N > T). GMM estimation is known to provide more reliable and efficient estimates, especially in models marked by serial correlation and heteroscedasticity, as noted by Adedoyin et al. (2017). Consequently, our study employs the GMM estimation technique to enhance the robustness of our empirical findings.

3. FINDINGS

Table 1 presents empirical results of the effects of climate change and key economic indicators on migration using various estimation techniques, including random-effects, fixed-effects and dynamic panel estimations, two step system GMM.

Table 1. Empirical results on the effects of the environmental degradation and economic indicators on migration using random-effects, fixed-effects, and the GMM estimations

	Random effects	Fixed effects	S.GMM
$MIGRATION_{t-1}$			0.2306***
RAI	-4.4087***	-24.7343***	-15.4569***
RAI_{t-1}			12.4272***
TEM	0.4662***	2.1552***	0.2354***
TEM_{t-1}			-0.0936
CO_2	-0.3085	0.9835	10.0172***
CO_{2t-1}			9.8439***
GROW	0.0700	0.1205	0.2032***
GDPPC	3.3841***	2.5808	3.7041***
UNEMPL	-0.2933	0.3098	0.2022**
TRADE	0.0159	-0.0454	0.0140
_cons	-4.5615	95.4036**	-17.6244***
Obs	279	279	245

Notes: **, *** significant at 5 per cent and 1 per cent, respectively.

When employing dynamic GMM estimation, several statistical tests indicate the appropriateness of the estimation. These tests encompass the Arellano-Bond test for AR(1) in first differences, yielding results of z = -2.17 with Pr > z = 0.030, and the Arellano-Bond test for AR(2) in first differences, yielding results of z = 0.42 with Pr > z = 0.674. Additionally, the Sargan test of overidentifying restrictions produces chi2 = 45.65 with Prob > chi2 = 0.753, while the Hansen test of overidentifying restrictions results in chi2 = 32.33 with Prob > chi2 = 0.989.

Results are consistent with previous findings and are also significant. In Model 1 (random effect), an increase in average temperature positively influences the net migration rate. It shows that a 1^0C increase in temperature increases net migration rate by about 0.466‰, but it is not showed significantly with model 2 (fixed effect) and model 3 (GMM). Similar results are documented in many findings (Backhaus et al., 2015; Beine and Parsons, 2017; Dallmann and Millock, 2017; Jha et al., 2017; Mastrorillo et al., 2016a; Nawrotzki and Bakhtsiyarava, 2017; Sedova and Kalkuhl, 2020a; Sloat et al., 2020a; Thiede et al., 2016b). However, This result is different from some other studies (Falco et al., 2018; Mueller et al., 2020b; Suckall et al., 2017). Interestingly, rainfall significantly and negatively affects the net migration rate. It shows higher levels of recent precipitation are negatively associated with proportions of the net migration rate in Asia. As precipitation increases by 1 per cent, so international migration rate increases by 15.46‰ (in GMM). Similar results are documented in many findings (Backhaus et al., 2015; Beine and Parsons, 2017; Dallmann and Millock, 2017; Falco et al., 2018; Mastrorillo et al., 2016; Mueller et al., 2020; Nawrotzki and Bakhtsiyarava, 2017). Interestingly, Mueller, Gray, and Kosec (2014) also show that the severity of rainfall

deviation has no effect on migration. On the other hand, this results is different with some previous findings (Cattaneo and Peri, 2016). Emission dioxide is revealed to have a favorable relationship with net migration rate. The result shows that for every 1 per cent increase in emission dioxide, net migration rate will increase by 10.02‰ (in model 3). Similarly, there are the significantly and positively relationship between trade openness, Gross domestic product per capita, economic growth and net migration rate. When the trade openness increases 1 percent, the net international migration rate increases 0.014‰. In addition, 1 per cent growth in Gross domestic product per capita increase net migration rate by 3,7‰. It also shows that a 1 per cent increase in economic growth rises net migration rate by about 0.203‰. Additionally, the unemployment rate increases 1 per cent lead to an increase 0.2 per thousands of net migration rate.

By applying the Dynamic panel-data estimation, two-step system GMM, the results of this estimation are reported in Table 1. With respect to our control variables, author find that net migration rate in our sample tend to be highly persistent over time, as we might expect. When the lagged migration rate increases 1‰ lead to increase 0.23‰ of the net migration rate. Author also find that a country's rainfall plays an important role in the size of its migration. However, the emission dioxide is seen with negative impacts over time to net migration rate in Asia. In Table 9, we use the economic growth of the respective country as an additional external instrument. We report the GMM estimates, the autocorrelation parameter is statistically significant and of similar magnitude. In the GMM estimates, it turns out to be positive and significant. We again find a change in the sign from negative to positive on the lagged RAI variable. When the lagged rainfall increases 1 per cent lead to increase 12.43‰ of the net migration rate. The model specification tests also indicate a well-specified model across the different specifications. In other hand, we again find a change in the sign from positive to negative on the lagged CO2 variable. When the lagged emission dioxide increases 1 per cent, net migration rate decreases 9.84‰. Migrant workers from emerging countries in our sample migrate for a better economic outcome. As such, increased CO_2 emission is considered a positive signal of economic activities of the destination countries, attracting more migrant workers to migrate for opportunities. However, if the destination country is considered polluted with a very high level of CO_2 emissions in the previous year, migration may decrease in response to the pollution.

4. CONCLUSION AND POLICY IMPLICATIONS

Countries in the Asian region have played an important role in connecting parts of the global economy. Asian countries such as Singapore, Malaysia, Thailand, Indonesia, and Vietnam have achieved the miracle of economic growth and social transformation in the past three decades. As a new dynamic region for economic growth, social development and transportation hub, the region has experienced labour movement in international integration. However, the effects of the environmental degradation and key economic indicators on the international migration, have largely been ignored in the existing literature. As such, this study examines the effects of these factors on migration using the dynamic panel estimation, two step system GMM. We find that increased temperature increases net migration in the Asian region. In addition, our empirical results indicate that rainfall decreases net migration. Interestingly, CO_2 emission is linked with increased migration in the Asian region. A polluted environment is sadly considered a signal of increased economic activities and a bad living environment. In addition, economic fundamentals such as economic growth and current income level per capita have increased the net migration in the past three decades. These empirical results remain largely unchanged across sub-samples depending on the income level.

Policy implications have emerged based on the findings of this study. First, our findings indicate that worker migrants in the Asian region migrate due to climate change,

including environmental degradation concerns. This finding is another important piece of evidence supporting the view that climate change is real and that climate change should be closely considered and incorporated into public policy to support economic growth and the migration issues. When the ageing population has become a key concern for many Asian countries, including emerging markets such as China, India, Indonesia, Malaysia, Philippines, Thailand, Vietnam, or other Asian countries where the international migration becomes problematic with the labour force. And one of the best ways, among other important objectives, is to improve environmental quality to attract migrants from other countries or create new works at the local area to manage the labour market in these countries. In addition, these countries need to predict and research issues of population, economic growth, environmental issues with the flows of international migration of Asian countries.

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