

# Statistical forecasting of U.S. and Central African Republic net migration

Tianqing Bei<sup>1,5</sup>, Hanlei Gao<sup>2</sup>, Ruiyang Gao<sup>3</sup>, Guangtong Shi<sup>4</sup>

<sup>1</sup>Rutgers University, New Brunswick, 08901, USA

<sup>2</sup>The British School Al Khubairat, Abu Dhabi, United Arab Emirates

<sup>3</sup>Weifang No.1 Middle School, Weifang, 261000, China

<sup>4</sup>Shanghai Shangde Experimental School, Shanghai, 200000, China

<sup>5</sup>tb647@scarletmail.rutgers.edu

**Abstract.** Immigration is a very important link in the current international society. This paper will study and predict the net immigration of the United States and the Central African Republic through two different models- drift model and ARIMA model, and to further explore the trends and influencing factors of migration between these countries. The results show that from 1960 to 2021, net migration from the United States and the Central African Republic showed very different trends. The United States, as a developed country, attracts a large number of immigrants from all over the world, while the Central African Republic, as a developing country, the flow of immigrants is mainly affected by economic, political and social factors in the region. Therefore, it can be seen that developing countries and developed countries have different impacts on the number of immigrants. This study provides a basis for further understanding of population migration and net migration of United States and Central African Republic.

**Keywords:** Net migration, migration, United States, Central African Republic, statistics.

## 1. Introduction

Immigration is one of the most important characteristics of modern society. In the era of globalization, ease of travel has become much more convenient, and transnational immigration has been increasing. The United States, as the world's leading immigration hub, inherently possesses an immigration phenomenon that is particularly significant. For centuries, immigrants have been an important part of American society and a cornerstone of the country's diverse culture. Over the past few decades, immigration and asylum policies in the United States have undergone profound changes [1], which have had a profound impact on net migration numbers.

The Central African Republic, as a crucial country on the African continent, also faces a complex and diverse migration situation. The changing social, political and economic conditions in the African region-for example, the effects of unemployment and environmental conditions between net migration-have also had a profound impact on net migration [2, 3]. The development, security and stability of African countries are closely linked to international migration. Using different methods of study (for instance, interpretation of net migration using sociological methodology [4], to investigate immigration phenomena in these countries can provide valuable insights for people to understand net migration patterns, as well as its influencing factors such as the quality of life and social adaptation [5]. In addition,

the comparative analysis of the migration phenomenon in these two countries can provide useful inspiration for the global migration research and provide reference for the international community to formulate appropriate policies. In past studies, scholars have extensively studied and reviewed the phenomenon of net migration.

In the field of immigration in the United States, the research involves the dynamics of immigration, policies, social integration, local labour market and other aspects [6]. Through empirical analysis, scholars illustrate the contribution of immigrants to economic growth, innovation, and cultural diversity in the United States. However, the effect of the great recession on the United States has also presented new topics and challenges for current research [7]. In the African region (especially the Central African Republic), migration studies have also attracted a surplus of attention. Instability, peace and security, and land and natural resources in the Central African Republic have an important impact on its net migration [8-10]. The researchers focused on the flow patterns of African migrants, the countries they entered, and the impact of net migration on national development; in particular, the unique geopolitical location of countries like the Central African Republic makes migration more complex and challenging.

In the literature review, the forecasts will make a comprehensive assessment of the phenomenon of migration, taking into account the historical, social and political considerations of the two countries. Through the analysis of historical data and research results, this essay will try to understand the deep reasons behind migration and make predictions for future migration scenarios. The objective of this study is to project future net migration based on an in-depth study related to these 10 aspects of migration phenomena in the United States and the Central African Republic by building models and analyzing histories.

## 2. Methods

### 2.1. Data source and explanation

The data source for this study is based on data provided by the World Bank, which covers macroeconomic, demographic and social information in a number of countries. This project will focus on net migration data for the United States and the Central African Republic, with in-depth analysis and projections.

The World Bank is an international financial organization that provides extensive macroeconomic and social development data on a global scale. This project will rely on World Bank databases to obtain relevant data, including net migration, to support the research and predictive analysis.

### 2.2. Indicator selection and explanation

2.2.1. *Net migration.* Net migration is the difference between the number of immigrants entering a country and the number of immigrants leaving the country. This indicator can help to understand the impact of immigration on a country's demographic changes and its contribution to the country's economic and social development.

2.2.2. *Gross domestic product (GDP).* GDP is a measure of a country's total economic activity, reflecting the country's economic strength and level of development. Analysing GDP data can help to understand the country's economic growth trends and the impact of the economy on the number of immigrants.

2.2.3. *Unemployment rate.* The unemployment rate is the percentage of people in a country's labour force who are not employed. This index can reflect the country's labour market situation and provide an important reference for analysing the immigration situation.

### 2.3. Method introduction

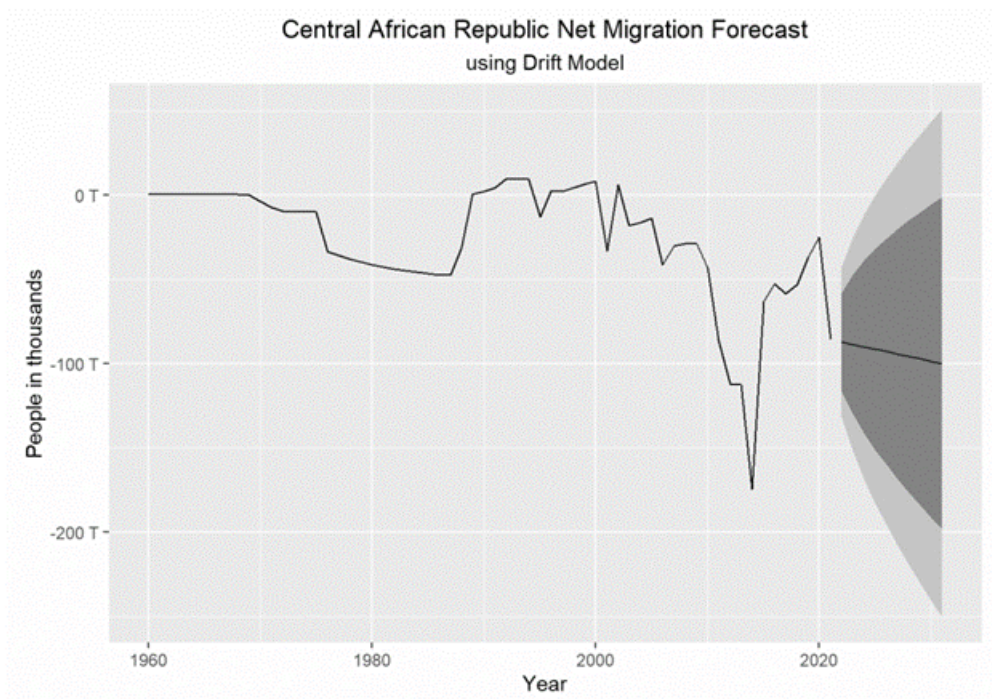
In order to analyse and forecast the net migration of the United States and the Central African Republic, we will use Drift Model, ARIMA Model and Linear Regression Model as an important analytical tool.

**2.3.1. Drift model.** Drift models are a time series analysis method often used to describe and predict phenomena that change over time. The model is based on the assumption of a linear trend, which assumes that variables drift or change linearly over time.

**2.3.2. ARIMA model.** ARIMA model is a statistical method commonly used in time series analysis and prediction, which is suitable for time series data with certain regularity, trend and seasonality. For net migration projections for the United States and the Central African Republic, using ARIMA model is also a choice for analysing historical data and predicting future trends. Based on the historical net migration data, this project will get the possible trend of future net migration through the parameter fitting and prediction of ARIMA model.

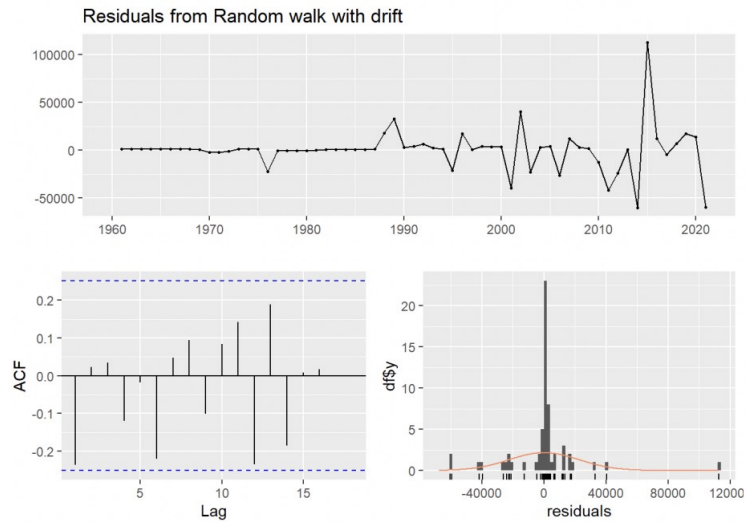
### 3. Results and discussion

Figure 1 shows the net migration forecast of Central African Republic. It is obvious that the number on the Y-axis of the image is negative, indicating that the number of Immigrants in the Central African Republic since 1960 is much smaller than the number of Emigrants. Moreover, net migration reached its lowest point around 2014, when it represented about 3 percent of the total population of the Central African Republic.



**Figure 1.** Drift model of Central African Republic net migration forecast.

In above Figure 1, the forecast line indicates the trends of the net migration. Even though it's on a downward trend, its coefficient has become much smaller than it was in the previous two years.

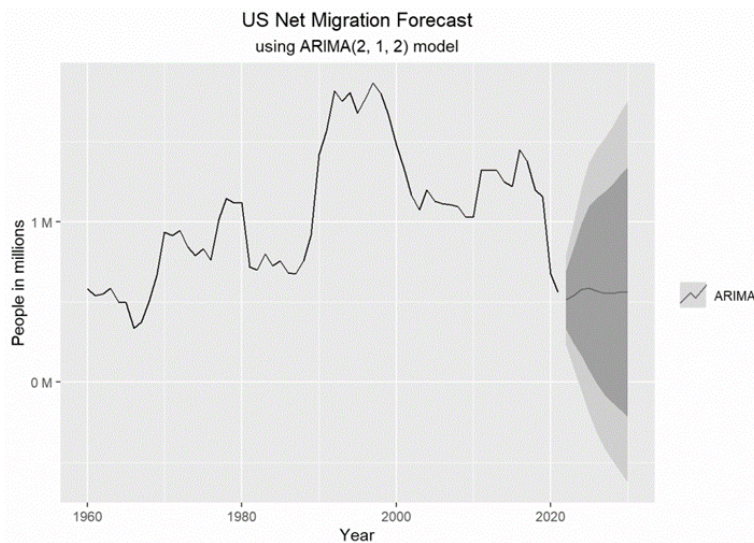


**Figure 2.** The analyse of net migration of drift model.

It's clearly showing the residuals of Central African Republic with drift model in Figure 2 which means drift model is an extremely good fit for the data. Meanwhile, the p-value of this model is 0.4261 which is much higher than 0.05. Therefore, the null hypothesis is accepted.

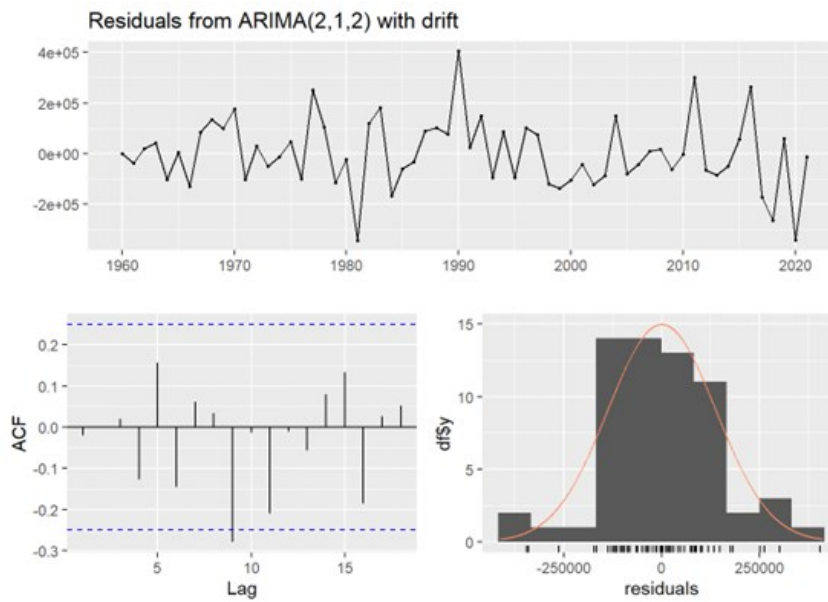
The Central African Republic has a very low net migration rate compared to the United States, and even a significant number of Central African Republicans have immigrated to the United States. As mentioned in the introduction, the population, economy, national strength and land resources of the Central African Republic are among the lowest in the world, making it a poor country in the true sense. These are the real reasons why the Central African Republic's net migration rate is so low. People always want a better life, since the Central African Republic doesn't give them what they need, they have to emigrate to other countries.

Central African Republic is one of the least developed countries in the world. Its economy is dominated by agriculture and its industrial base is weak. More than 80% of its industrial products are imported. Moreover, the government of the Central African Republic was overthrown by rebels in 2013, which is the main reason for the precipitous decline in net migration in Figure 1 (2013-2017). When society is in turmoil, people tend to go to a more comforting place to live, so emigration has become a necessary choice.



**Figure 3.** ARIMA (2, 1, 2) model of US net migration forecast.

Figure 3 shows the number of US net migration from 1960 to 2021 and the ARIMA (2, 1, 2) model of US net migration forecast. The values on the Y-axis are all positive, which illustrate that the number of immigrants in United States is greater than the number of emigrants. The maximum value of net migration occurs in 1997 and the lowest one is 1966's. The forecast line shows that the number of net migrations from 1960 to 1997 have an upward trend, which reaches the highest in 1997 and over the next 24 years, net migration tends to decrease.



**Figure 4.** The analysis of ARIMA (2, 1, 2) model of US net migration forecast.

The residuals are illustrated in Figure 4. The image at the bottom right shows that the residuals are approximately distributed normally. In addition, the p-value is 0.1037, which is higher than 0.05, so that the null hypothesis is accepted. Both above conditions display that the ARIMA (2, 1, 2) model fits.

For the data of net migration, it is obvious that the numbers are related to policy, economic and other factors which are mentioned in introduction section. For example, the quantities of net migration increased substantially, which may be positively affected by Immigration Reform and Control Act of 1986 and Immigration Act of 1990. The two acts increased the number of immigrants and expanded the categories of immigrants. Meanwhile, the unemployment rate has fallen significantly in the 1980s in United States. Another example is the sharp decline in net migration after 2019. Due to the Covid-19 and the pandemic period, it may be related to the closure between countries. As one of the most developed countries, the United States have positive policies and ascendant living conditions which can be provided. People who want to immigrate or settle in United States can obtain more work and earning opportunities which can make them lives better. Therefore, the number of net migration in United States is stubbornly. For the forecast, the ARIMA (2, 1, 2) model shows us that future migration may tend to stick around 0.5 million immigrants, like the time period near the 1960's. The quantities may be affected continuing impact of epidemic. But the download trend can stop in 2022 and the numbers may be steady gradually in the model.

#### 4. Conclusion

In conclusion, the net migration of United States and Central African Republic above shows that they will level off in the next 10 years. Because the Central African Republic is one of the poorest countries in the world, its citizens tend to go to more developed countries, so its net migration has been consistently negative. As the most developed country in the world, the United States has a high net migration rate, which is not only because of its own attraction, but also because of the influence of some

policies conducive to immigration. In the previous part, although the two countries are very different in terms of GDP, population, resources, security etc., their net migration has shown a downward trend since 2019, which is due to the impact of the global factor (COVID-19). In addition, national security has always been one of the main reasons leading to the change of immigration rate. The United States has always been in a state of peace, so the net migration in the United States has been steadily rising. The Central African Republic in the past few years, civil war, serious loss of nationals. However, as can be seen from the previous figure, the loss of Central African nationals caused by war has also been alleviated to some extent in recent years.

As a result, United States, as a developed country, typically attracts a significant number of immigrants due to its robust economy, high living standards, and multicultural society. In contrast, the Central African Republic, as a developing nation, has lower attractiveness, resulting in fewer net migrants. Also, Net migration trends in the United States tend to remain relatively stable, and has a seasonality, albeit influenced by external factors. The Central African Republic may experience more significant fluctuations due to factors such as political instability, economic volatility, etc. However, both of them have had a dramatic download from 2019. Because of the COVID-19, policy changes have made the countries blocked and the states of economic development are not optimistic.

In summary, statistical analysis using models provides valuable insights into net migration trends and disparities between different countries, aiding policymakers in managing and addressing immigration effectively. These insights can be utilized to promote economic growth, social stability, and human rights protection.

#### **Authors contribution**

All the authors contributed equally and their names were listed in alphabetical order.

#### **References**

- [1] Paul W S 2001 An Overview and Critique of US Immigration and Asylum Policies in the Trump Era. *Journal on Migration and Human Security*, 3.
- [2] Baumann R, Svec J and Sanzari F 2015 The Relationship between Net Migration and Unemployment: The Role of Expectations. *Eastern Economic Journal*, 41(3), 443–458.
- [3] Nguyen H T 2019 The Effect of Health Environment on Migration Flows. *Migration Letters*, 4.
- [4] Lieberman S 1980 The Interpretation of Net Migration Rates. *Sociological Methodology*, 11, 176–190.
- [5] Liu B 1975 Differential Net Migration Rates and the Quality of Life. *The Review of Economics and Statistics*, 57(3), 329–337.
- [6] Boustan L P, Fishback P V and Kantor S 2010 The Effect of Internal Migration on Local Labor Markets: American Cities during the Great Depression. *Journal of Labor Economics*, 28(4), 719–746.
- [7] Johnson K M, Curtis K J and Egan-Robertson D 2017 Frozen in Place: Net Migration in sub-National Areas of the United States in the Era of the Great Recession. *Population and Development Review*, 43(4), 599–623.
- [8] Kisangani E F 2015 Social Cleavages and Politics of Exclusion: Instability in the Central African Republic. *International Journal on World Peace*, 32(1), 33–59.
- [9] Fafore O A 2016 The African Union and Peace and Security in Central Africa. *Journal of African Union Studies*, 5(2), 51–66.
- [10] Huggins C 2022 Land, High-Value Natural Resources, and Conflict in the Central African Republic. *University of Toronto Press*.