Unraveling Egypt's Net Migration Patterns: A Time Series Analysis

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***Abstract*—*This study investigates Egypt's net migration patterns from 1965 to 2022 using time series analysis. The research explores correlations between net migration and various factors including population, GDP, inflation, and exchange rates. Findings reveal a moderate positive correlation between net migration and total population ($r \approx 0.42$). A negative correlation is observed between net migration and GDP growth ($r \approx -0.33$), suggesting a decrease in annual GDP growth with increasing net migration. However, other variables exhibit weak correlations. The analysis suggests that inward migration might be linked to regional conflicts, such as seeking refuge during these conflicts, while outward migration could be caused by internal instabilities such as war, revolutions and economic struggles. The paper concludes that while some connections exist, more research is needed to fully understand the complex interplay of factors influencing Egypt's net migration patterns.*

Keywords*—*Egypt, GDP, Population, Net Migration, Inflation, Pearson's Correlation, Time Series Analysis

1. Introduction

Migration stands as a fundamental force shaping human history, fostering the emergence of societies, civilizations, and cultures. This intricate process involves the movement of individuals between different locations, spurred by a myriad of factors such as economic opportunities, geographical conditions, and political developments. Egypt, with its rich history and strategic location, has long been a destination for migrants. Over the past 60 years, It played a vital role and participated in many crucial events geographically and politically and welcomed many migrants from all over the world especially from The Middle East and North Africa (MENA) region, due to several disturbances and conflicts occurring over those years. Additionally, Egypt itself had witnessed some cases of instability ranging from economic to political issues, which led to many cases of migration outside the country.

1.1. Explanation

The concept of net migration, depicting the balance between immigrants and emigrants, is crucial in understanding the demographic landscape of a country. A positive net migration occurs when a nation witnesses more incoming immigrants compared to those leaving, whereas a negative net migration signifies a higher number of individuals departing than arriving. Egypt is positioned as a pivotal point for both immigration and emigration, reflecting the dynamic nature of global migration patterns. Examining migration data of Egypt can reveal insightful trends, providing a window into the region's social and economic dynamics.

1.2. Specs

The World Bank Open Data platform [1], hosting a wealth of statistical information, serves as a valuable resource for our analysis. With data encompassing a broad spectrum of subjects and covering 189 member nations, the platform offers a comprehensive view of the factors influencing migration trends. By delving into this data, we aim to unravel the intricate interplay between migration patterns and the multifaceted changes in Egypt's demographic, political, and economic landscape. All data was gathered and can be found on World Bank Open Data.

Variables used for this analysis:

1. Population, total.
2. Population growth (annual %).
3. GDP (current US$).
4. GDP growth (annual %).
5. Inflation, GDP deflator (annual %).
6. Net migration.
7. Official exchange rate (LCU per USD, period average).

With *Net migration* being our target variable.

2. Objectives

Studying and analyzing the net migration of Egypt and trends relevant. We try to find and study the correlation between net migration and other factors such as Egypt's population, GDP and Inflation. This research seeks to unravel the potential linear relationships, where we specifically seek to:

1. Determine the trend of Net Migration in Egypt from 1965-2022.
2. Find whether there is a statistically significant linear relationship between net migration and (1) Population, total, (2) Population Growth (annual %), (3) GDP (current US$), (4) GDP growth (annual %), (5) Inflation, GDP deflator (annual %), (6) Official exchange rate (LCU per USD, period average).
3. Explain the correlation and linearity findings and how they reflect demographic,political and economic events.

3. Data Preparation and Cleaning

We tried locating any N/A (Not Available) values in our dataset. We found a concentration of them between the years 1960 to 1964. Those missing values were in *GDP (current US$)*, *GDP growth (annual %)*, *Population growth (annual %)*, and *Inflation, GDP deflator (annual %)* variables. We handled this obstacle by neglecting those years in order to keep the data completely accurate.

4. Net Migration Factors Analysis

This section discusses and illustrates some insights from each variable we suspect having a relation with Net Migration.

4.1. Population, total

Statistical Overview:

1. Mean: 64716700.50
2. Median: 62079023.50
3. Minimum: 30818469.00
4. Maximum: 110990103.00
5. Std: 23956874.96

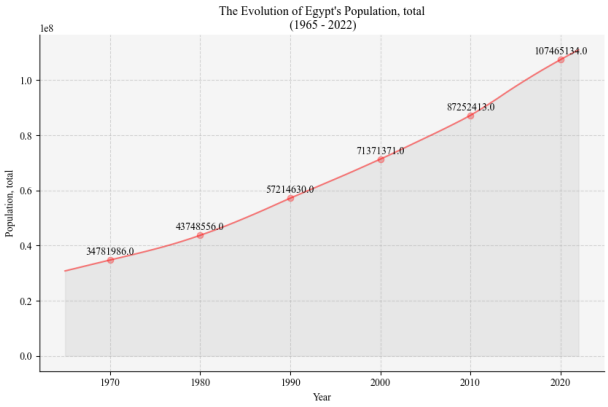

Figure 1. *Egypt's Population Total Over Time (1965-2022)*

As Figure 1 illustrates, Egypt's total population has witnessed a steady annual increase over the years, reaching 107 million individuals in 2020.

4.2. Population growth (annual %)

Statistical Overview:

1. Mean: 2.25
2. Median: 2.21
3. Minimum: 1.57
4. Maximum: 2.76
5. Std: 0.29

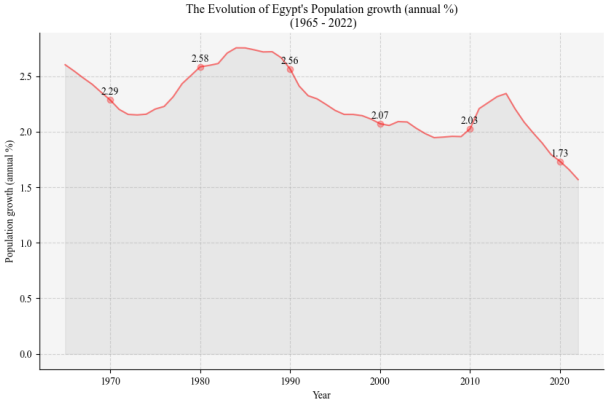

Figure 2. *Egypt's Population Growth Over Time (1965-2022)*

Figure 2 represents Egypt's population annual growth, subsequently, Egypt's population growth is decreasing steadily in contrast to the total population as stated in figure 1.Dropping from previous years to 1.73% in 2020.

4.3. GDP (current US$)

Statistical Overview:

1. Mean: 108708208280.85
2. Median: 49238307422.61
3. Minimum: 4948667540.41
4. Maximum: 476747720364.74
5. Std: 122455066218.73

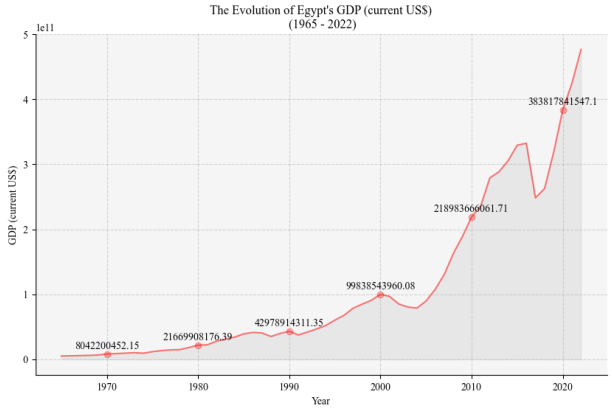

Figure 3. *Egypt's GDP Over Time (1965-2022)*

Concerning Egypt's annual GDP, figure 3 illustrate that Egypt exhibit positive growth trends, reaching 380$ billion in 2020 propelled by Egypt's contributions from oil production, tourism, and agriculture.

4.4. GDP growth (annual %))

Statistical Overview:

1. Mean: 4.99
2. Median: 4.83
3. Minimum: -1.61
4. Maximum: 13.28
5. Std: 2.51

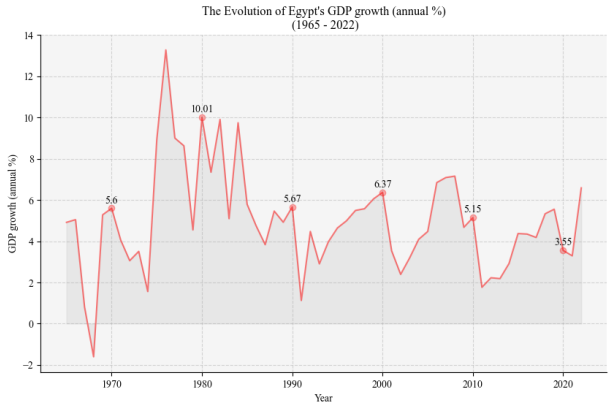

Figure 4. *Egypt's GDP Growth Over Time (1965-2022)*

Figure 4 illustrate Egypt's annual GDP growth, where we can notably observe that the annual growth rate is readily fluctuating. The fluctuation can be explained if we take a look at the region's conflicts and wars. Firstly the major drop of 1967 is result of Israel assault on Egypt beginning the Six-Day war, stabilisation is reflected after a decade where the growth rate reached an all time maximum of around 13%. The next drop of 1990 is due to the start of the Gulf War, a decade latter the Second Intifada occurred which explains the next decrease. Lastly the decrease of 2011 is due to the Arab Spring, and the 2011 revolution in Egypt respectively.

4.5. Inflation, GDP deflator (annual %)

Statistical Overview:

1. Mean: 10.01
2. Median: 9.90
3. Minimum: -2.20
4. Maximum: 29.52
5. Std: 6.27

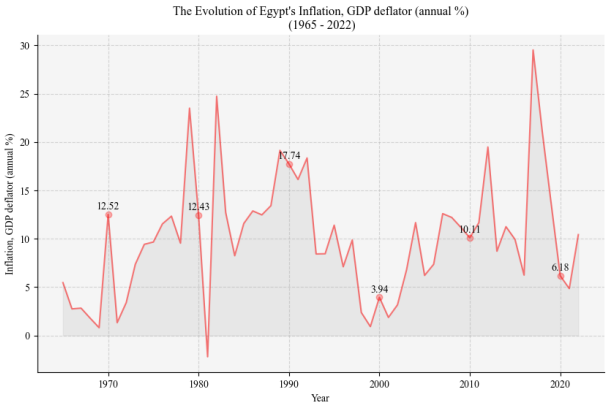

Figure 5. *Egypt's Inflation Over Time (1965-2022)*

Figure 5 illustrate Egypt's inflation rate over the years, the fluctuation are mainly due to global or domestic economic crises and local currency devaluation. Notably Egypt's lowest inflation rate was in 1981 and it's highest of 29% in 2017.

4.6. Net migration

Statistical Overview:

1. Mean: -26604.93
2. Median: -27172.50
3. Minimum: -144535.00
4. Maximum: 163449.00
5. Std: 56275.83

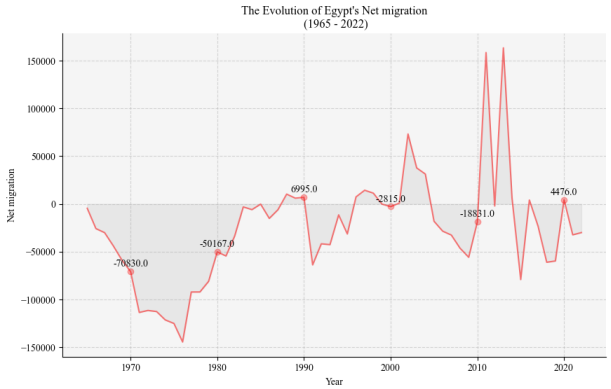

Figure 6. *Egypt's Net Migration Over Time (1965-2022)*

Figure 6 illustrate Egypt's Net Migration, generally oscillating within the range of +/- 150,000. Notably from 1965 till 1988 Egypt witnessed a negative flow of net migration, and in the years following the 2011 revolution Egypt experienced a significant surge of nearly 300,000 migrants.

4.7. Official exchange rate (LCU per USD, period average)

Statistical Overview:

1. Mean: 4.30
2. Median: 3.37
3. Minimum: 0.39
4. Maximum: 19.16
5. Std: 5.00

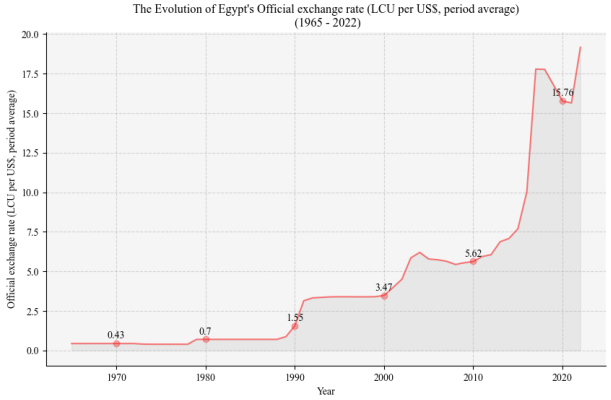

Figure 7. *Egyptian pound vs US dollar Over Time (1965-2022)*

The Egyptian pound (EGP) exchange rate against the US dollar (USD) steadily increased, where 1 USD equated to around 0.43 EGP in 1970 while 1 USD equated to around 15.8 EGP in 2020 as shown in Figure 7. The gradual depreciation of the Egyptian pound (EGP) against the US dollar (USD) over the years can be attributed to a combination of factors, including inflation, domestic economic conditions, insufficient foreign exchange reserves and external debt.

5. Net Migration Correlations Analysis

This section discusses and provides illustrations and information about the relations between each explanatory variable and Net Migration.

5.1. Net migration vs Population Total

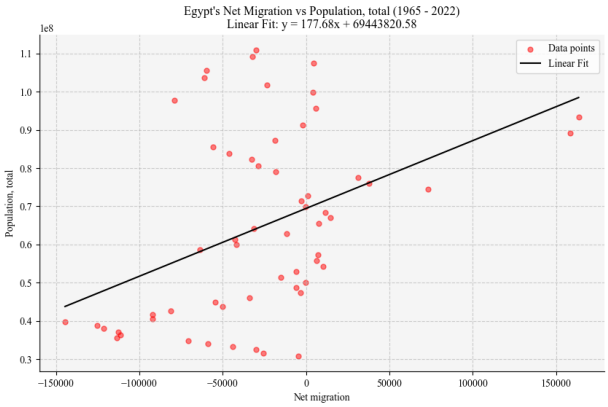

Figure 8. *Net Migration versus Population Total*

As Figure 8 illustrates, the Pearson's correlation coefficient between Egypt's Net Migration and Total Population between 1965 and 2022 is approximately 0.42. This positive correlation suggests a moderate, positive linear relationship between the two variables. In simpler terms, as Egypt's net migration increases or decreases, there tends to be a corresponding increase or decrease in the total population, though the relationship is not extremely strong.

5.2. Net migration vs Population growth

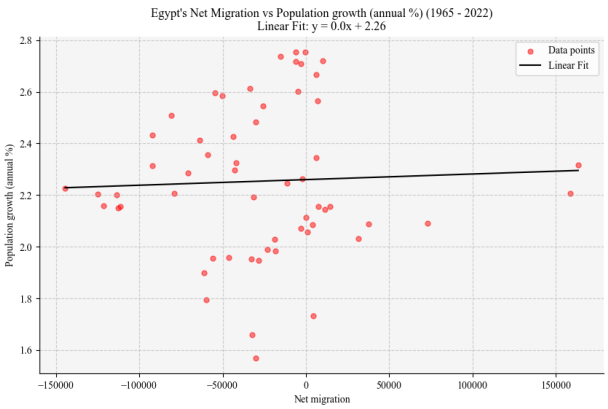

Figure 9. *Net Migration versus Population Growth*

As Figure 9 illustrates, the Pearson's correlation coefficient between Egypt's Net Migration and Population Growth (annual %) from 1965 to 2022 is approximately 0.04. This low correlation indicates a weak, almost negligible linear relationship between the two variables. In practical terms, there is little evidence to suggest a consistent or significant association between changes in net migration and the annual percentage growth of the population in Egypt during this time period.

5.3. Net migration vs GDP(current US$)

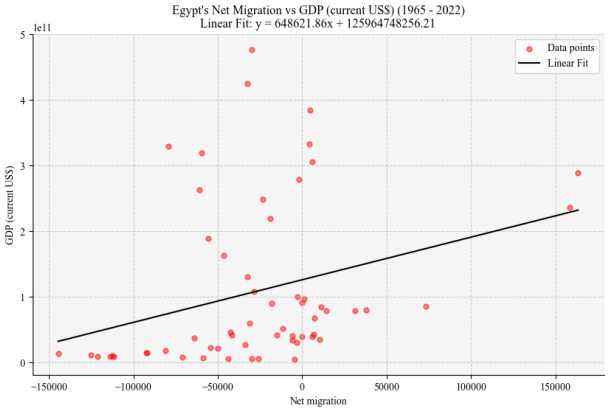

Figure 10. *Net Migration versus GDP (current US$)*

As Figure 10 illustrates, the Pearson's correlation coefficient between Egypt's Net Migration and GDP (current US$) from 1965 to 2022 is approximately 0.30. This positive correlation suggests a moderate, positive linear relationship between the two variables. In simpler terms, as Egypt's net migration increases or decreases, there tends to be a corresponding increase or decrease in the GDP, though the relationship is not extremely strong.

5.4. Net migration vs GDP growth (annual %)

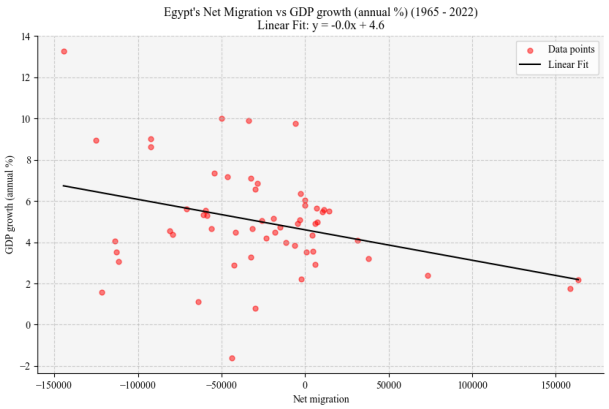

Figure 11. *Net Migration versus GDP Growth*

As Figure 11 illustrates, the Pearson's correlation coefficient between Egypt's Net Migration and GDP Growth (annual %) from 1965 to 2022 is approximately -0.33. This negative correlation indicates a moderate, negative linear relationship between the two variables. In simpler terms, as Egypt's net migration increases, there tends to be a corresponding decrease in the annual percentage growth of the GDP, and vice versa.

5.5. Net migration vs Inflation, GDP deflator (annual %)

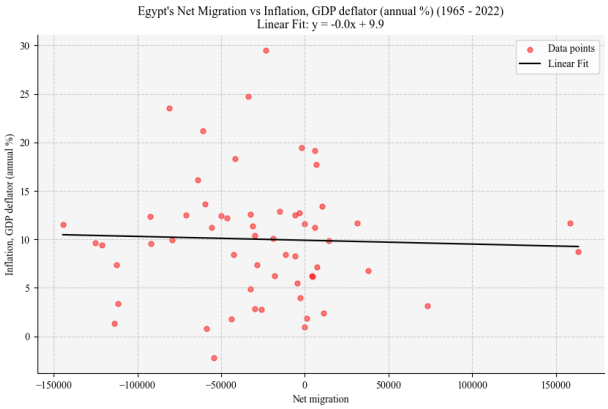

Figure 12. *Net Migration versus Inflation*

As Figure 12 illustrates, the Pearson's correlation coefficient between Egypt's Net Migration and Inflation, GDP deflator (annual %) from 1965 to 2022 is approximately -0.04. This indicates a very weak, almost negligible linear relationship between the two variables. In simpler terms, there is little evidence to suggest a consistent or significant association between net migration and the annual percentage change in the GDP deflator (a measure of inflation) in Egypt during this time period.

5.6. Net migration vs Official exchange rate (LCU per US$, period average)

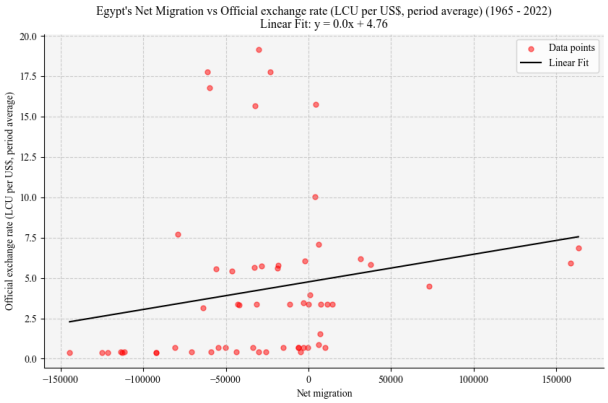

Figure 13. *Net Migration versus USD Exchange Rate*

As Figure 13 illustrates, the Pearson's correlation coefficient between Egypt's Net Migration and the Official Exchange Rate (LCU per US$, period average) from 1965 to 2022 is approximately 0.19. This positive correlation suggests a weak, positive linear relationship between the two variables. In simpler terms, as Egypt's net migration increases or decreases, there tends to be a corresponding increase or decrease in the official exchange rate, though the relationship is relatively weak.

6. Findings and Conclusions

After exploring and trying to find correlations and connections between our explanatory variables and Net Migration, we found the following:

1. In figure 6, we witnessed a negative net migration and constant declination between 1965 1973 which was probably due to the 1967's *Six-Day War* up until 1973's Egypt's victory in *The Sixth of October War*. The net migration kept value kept increasing from the late seventies until it reached a positive value in the late eighties for the first time since 1965. it kept oscillating over the next years between positive and negative values due to many factors ranging from conflicts happening in MENA region such as The Gulf War, *The US Invasion of Iraq*, *Syria's Civil War*, *Israel Colonial Settlement in Palestine*. And also internal disturbances inside of Egypt such as *2011 and 2013 Revolutions* and the Egyptian Pound Flotation in 2016.

2. We witnessed the highest correlation between Net Migration and the Population Total ($r \approx 0.42$) which suggests a moderate positive correlation. But it does not give any insights beyond that as it is only logical to assume an increase in the population due to migration due to citizenship appliers and other similar factors.

3. we witnessed a negative correlation between Net Migration and the GDP Annual Growth ($r \approx -0.33$), this suggests a decrease over time in the annual GDP's Growth as Net Migration Increase, but we cannot conclude an actual relation due to the possibility of having several confounding variables and outliers in the GDP Growth such as Egypt's *2011 Revolution* and others factors.

4. For most of the other variables, we witnessed moderate to weak correlation with the Net Migration, which does not give any further insights. Figure 14 below gives us more insights about the correlations:

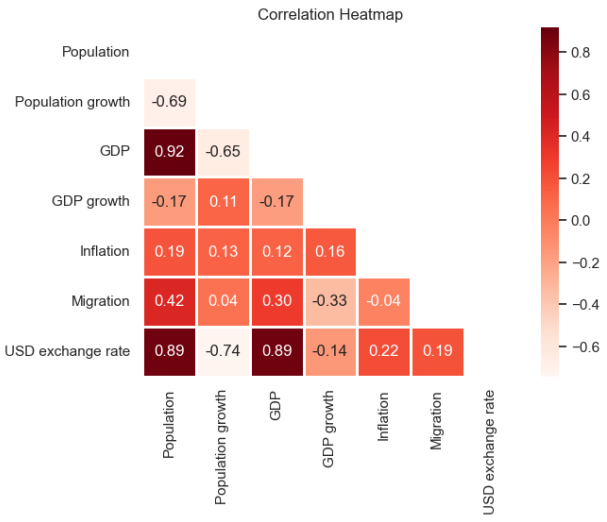

Figure 14. *Correlation Heat map*

Figure 14 represent a correlation heat map, where the intensity of the color represents the strength of the correlation, with darker colors indicating stronger correlations. Whereas lighter colors indicates weaker correlations, however it's important to state that **correlation does not imply causation**. Meaning if two variables correlation is a strong one, it does not mean that one variable causes the other.

From this analysis, we can conclude that most of these variables does not have a powerful effect or correlation on the net migration. We can predict that the inward migration most probably comes from international conflicts that concern Egypt either geographically or politically. Consequently, this topic needs further investigation.

References

[1] *The world bank open data platform*, https://data.worldbank.org, 2024.