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CRIME TRENDS IN EMERGING AFRICAN AND ASIAN COUNTRIES (2010–2023)

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ABSTRACT
This study examines crime rate trends from 2010 to 2023 across selected emerging nations in Africa and Asia using linear mixed-effects modelling and clustering analysis. By analysing data from 12 countries, we identified significant temporal patterns and regional variations. Clustering analysis grouped countries into four distinct clusters based on crime rate similarities. Linear mixed model revealed significant overall decrease in crime rates over time.

KEYWORDS: *Crime Rate, Linear Mixed-Effects Modelling, Clustering Analysis, Emerging Economies, Temporal Patterns, Regional Variations, Asia, Africa.*

INTRODUCTION

Crime remains a critical issue affecting socio-economic development and public safety worldwide. Understanding crime trends is essential for formulating effective policies and interventions. This study focuses on selected emerging countries in Africa and Asia, regions that have experienced varied economic growth and social changes over the past decade. By analysing crime rates from 2010 to 2023, we aim to uncover temporal and regional patterns that can inform policymakers and stakeholders.

METHODOLOGY

Data Collection

Crime rate data were collected from World Bank's Data Bank for 12 emerging countries across Africa and Asia from 2010 to 2023. The countries included Kenya, Ghana, Rwanda, Egypt, Tanzania, Morocco, India, Vietnam, Bangladesh, Thailand, Malaysia, and China. The dataset comprised annual crime rates per country, totalling 168 observations.

Statistical Analysis

Linear mixed-effects model was employed using the 'lme4' package in R to analyse the effect of time on crime rates, accounting for random effects due to region and country:

$$\text{CrimeRate}_{ij}=\beta_0+\beta_1\text{Year}_i+u_j+v_{ij}+\epsilon_{ij}$$

where u_j represents the random effect of the region, v_{ij} the random effect of the country within the region, and ϵ_{ij} the residual error.

Clustering Analysis

K-means clustering was performed to group countries based on their crime rates. The optimal number of clusters (k=4) was determined heuristically. Clusters were analysed to identify patterns and characteristics within and between groups.

Visualization

Crime rate trends and cluster memberships were visualized using 'ggplot2' in R, facilitating comparative analysis across countries and time.

RESULTS

Linear Mixed-Effects Model

The mixed model indicated a significant negative relationship between year and crime rate (Estimate = -0.09815, t = -6.861), suggesting an overall decline in crime rates over the study period. The model accounted for random effects at the region and country levels, with variances of 0.1094 and 2.2116, respectively.

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Clustering Analysis

The k-means clustering resulted in four clusters:

- Cluster 1: Low crime rates (Avg. = 0.691), including China and Malaysia.
- Cluster 2: High crime rates (Avg. = 5.78), featuring Thailand, Kenya, and Tanzania.
- Cluster 3: Moderate-low crime rates (Avg. = 1.68), comprising Egypt, Vietnam, Morocco, Malaysia, Ghana, Thailand, Bangladesh, Rwanda, and Tanzania.
- Cluster 4: Moderate-high crime rates (Avg. = 3.10), including Bangladesh, Egypt, Tanzania, Rwanda, India, Kenya, and Thailand.

Visualization

The plotted crime rates (Figure 1) illustrated the individual country trends and their cluster memberships over time. The visualization highlighted the dynamic nature of crime rates in different countries and how they shifted between clusters.

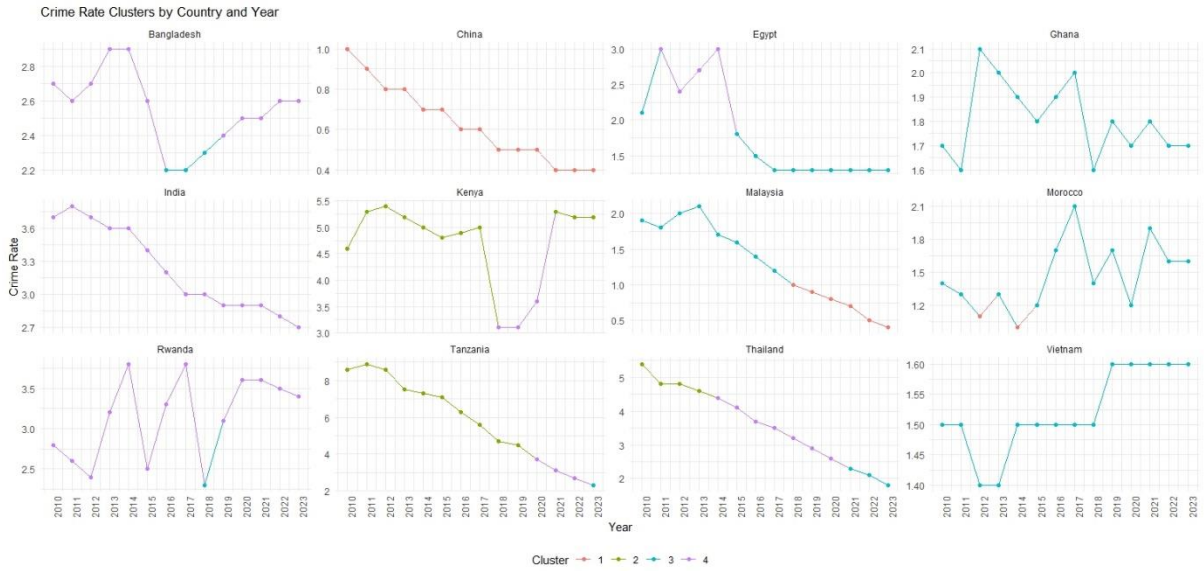


Fig. 1 Crime Rates by Country and Year

DISCUSSION

The significant negative trend identified by the mixed model aligns with global efforts toward crime reduction and improved law enforcement strategies. The substantial random effect variance at the country level indicates heterogeneity among countries within regions, emphasizing the need for country-specific analyses.

The clustering analysis revealed that countries like Thailand and Tanzania transitioned from higher to lower crime rate clusters over time, reflecting positive trends in crime reduction. Conversely, fluctuations in countries like Kenya and Rwanda underscore the need for adaptive strategies responsive to changing crime patterns.

Africa: The African nations of Kenya, Ghana, Morocco, Rwanda, Tanzania, and Egypt display more varied trends. Tanzania and Rwanda, for instance, show significant fluctuations in crime rates, while Ghana and Morocco demonstrate relatively stable but fluctuating patterns. Egypt's recent stability at lower crime rates might indicate successful security measures implemented in the last decade.

Asia: Countries like India, Malaysia, Thailand, and Vietnam exhibit a general downward trend in crime rates, which can be seen as indicative of effective law enforcement strategies, socio-economic development, and possibly improvements in legal frameworks. China and Vietnam maintain very low crime rates, suggesting strong governmental control and surveillance capabilities.

CONCLUSION

This study highlights significant declining trends in crime rates across emerging countries in Africa and Asia from 2010 to 2023. The combination of mixed-effects modelling and clustering analysis provided a nuanced understanding of temporal and regional patterns. Country-specific observations underscored the importance of tailored interventions.

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DATA AND CODE AVAILABILITY

The R code, along with input and output files used in this research, are available in the following GitHub repository:
https://github.com/thomasalona3/p002