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Research Article

## Household Inflation Patterns in Malaysia: A Data-Driven Analysis using AI

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**Abstract:** The cost of living among Malaysian households has increased significantly as inflation has grown faster than household income. This issue particularly affects urban residents, where living expenses are substantially higher than those in rural areas. This study examines household inflation trends in Malaysia between the year 2020-2024 using data obtained from the Department of Statistics Malaysia (DOSM). After data cleaning and filtering, Python-based artificial intelligence tools are employed to identify and categorize current household inflation patterns. The findings are then visualized using interactive Power BI dashboards to enhance clarity and support accessible interpretation for a wide range of audiences.



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## 1. INTRODUCTION

Inflation in the household sector is a matter of concern for many economies and Malaysia is no exception. Over the past few decades, local households have faced increasing financial pressure as inflation rates have risen and usually outpace increments in salaries. Lawal (2010) stated that price increases in essential goods and services including food, transportation and housing have a direct

influence on the purchasing power of households particularly among those in low-income groups. In response to rising living costs, households have to optimally adjust their consumption patterns while saving behaviour will change and overall economic welfare may eventually decrease. Yusof et al. (2021) noted that the persistent raising inflation affects income distribution and expenditure patterns. The lower-income and more vulnerable households are experiencing greater adverse effects.

Household inflation in Malaysia is caused by both domestic and global factors. On the domestic front, government policies, wages growth and the housing prices have been key factors of inflation. Ma'in et al. (2016) explained how macroeconomic variables such as housing prices and Gross Domestic Product (GDP) growth led to pressures of inflation in the household sector. Higher housing prices and strong demand in urban areas make households spend more. At the same time, Malaysia depends heavily on imported goods for its basic needs. Therefore, when global prices for oil, food commodities or exchange rates are rising, living costs increase further. These external factors contribute to increasing inflationary pressures of low-income households, especially for households that allocate a higher percentage of their income to basic needs (Ma'in et al. (2020).

Inflation expectations, or the households' views concerning future movements in prices, is an important determinant for household behaviour. Elevated inflation expectations may lead households to increase present consumption as they anticipate higher prices in the future, which in turn adds to inflationary pressure. Abu Bakar and Abdul Ghani (2019) stressed that most households in Malaysia, especially among low-income families and larger family size households do show a higher level of inflation expectation compared with an actual inflation rate; it will contribute towards the impact to their spending behaviour. D'Acunto et al. (2022) have reported similar patterns elsewhere in the world, as they found that households' spending on durable goods has been associated primarily with consumers' inflation expectations, notably in emerging countries. Policymakers need insights into the dynamics of household inflation, its antecedents and consequences. It allows them to employ policies that might serve to lessen the negative effects of inflation on society and especially disadvantaged segments.

The primary objective of this study is to investigate household inflation patterns in Malaysia between year 2020 and 2024. Specifically, the study aims to identify and classify household inflation trends, analyze differences across household groups, and provide insights into how inflation has affected consumption and expenditure behavior during this period. By achieving these objectives, the study seeks to inform policymakers of the dynamics and consequences of household inflation, supporting the design of targeted interventions to mitigate the negative impact of inflation, especially on disadvantaged segments of society. To accomplish these objectives, the study utilizes secondary data obtained from the Department of Statistics Malaysia (DOSM) covering the years 2020 to 2024. The data are first cleaned and filtered to ensure accuracy and consistency. Python-based artificial intelligence techniques are then applied to identify, classify, and model household inflation patterns. Finally, the results are visualized using interactive Power BI dashboards to enhance interpretability, allowing policymakers, researchers, and other stakeholders to monitor trends effectively and make evidence-based decisions.

## 2. LITERATURE REVIEW

There are a few factors that contribute to inflation at the household level in Malaysia, such as the money supply, interest rate and exchange rate, among others. Islam et al. (2017) analyzed the main economic determinants of inflation in Malaysia and indicated that money supply, interest rate, and exchange rate are significant drivers of inflation. They then pointed out that the money supply has a direct effect on inflation – specifically, the more money available, the more goods and services will be demanded as people pay for those goods and services. The results of this study highlighted the

importance of proper monetary policies in maintaining the circulation of money while controlling inflation. This study also examined the effect of external influences, such as world food and energy prices that provided great pressure on household inflation in Malaysia, particularly during times of economic volatility.

Ma'in et al. (2016) and the relation between macroeconomic variables and household debt, which is an indirect determinant of domestic inflation. They discovered that factors such as the housing price index, gross domestic product (GDP), and unemployment rate are important in determining household-centred debt levels, which in turn influence inflation. This, for instance, increases housing prices that in turn push up household expenditure especially in urban areas and contribute to inflationary pressures. Excessively, the short-term and third, GDP growth rates are also positively related to household borrowing, since high income accountholders borrow more than low-income households where more lending means a higher inflation will be provoked. The research urged a measured approach to debt to guard against higher inflation faced by families.

Yusof et al. (2021) also elaborated on the domestic determinants of inflation specifically government expenditure, unemployment and exchange rates. Their results discovered a meaningful correlation between government expenditure and inflation, especially during periods when fiscal spending was escalated for development works. Also foreign exchange was directly causing the imported goods price and it could affect the general prices level in Malaysia. This research also underscored the need to achieve stable domestic and external elements in order to control inflation.

On the other hand, Ma'in et al. (2020) studied the influence of households' consumption expenditure on inflation and emphasized the differences in urban and rural household expenditures. They observed that the urban households with higher cost of living respond more to inflationary shocks relative to the rural sector of the economy. The discrepancy in price structures, when added to the influence of commodity markets, worsens inflation for the former. The authors recommended targeted fiscal policy to provide subsidies or to regulate the prices of basic commodities, which could ease some of the stress on PUs.

D'Acunto et al. (2022) offered a global view by examining how inflation expectations in Malaysia and abroad impact on consumer behaviour and household inflation. They said that households with high inflation risk perceptions change their consumption behavior and push prices higher. This is even more pronounced in a country such as Malaysia where the inflation rate is not met with expected inflation. The results emphasize the role of public perception and expectation management in reining in inflation rates.

Abu Bakar and Abdul Ghani (2019) investigated the impact of household inflation expectations on consumption behaviour in Malaysia. They employed data from the Bank Negara Malaysia Consumer Sentiment Survey (BNM CSS) and concentrated on how households construct their inflation expectations. In the research findings of Chai and Yi (2008), it is underlined that households use a combination of both backward-looking factors (inflation in the past, shopping experiences recently) and forward-looking economic conditions to form expectations. They found that households' inflation expectations exceed realized inflation, particularly for low-income and large families. In this manner perceived inflation is higher than actual inflation, and spending appears more subdued. The tendency for households to overestimate future inflation underscores the importance of communications by policy makers to anchor expectations and help keep the economy on an even keel.

Burke and Ozdagli (2020) explored the effect of consumer inflation expectations at the household level on consumption, with a special emphasis on durable goods. They were using survey panel data on U.S. households to determine if higher expectations of inflation translate into a greater likelihood of spending more money. Although their focus was on US data, the results should be

applicable to Malaysia in light of a similar economic environment under interest rates and inflation expectations. They discovered that people with higher educational attainment or those who had mortgages did increase their purchase of durable goods, but not as much. Implying in contrast that inflation expectations might activate the consumption of more convenient groups but do not explain much variation in nondurable goods spending. Moreover, their study found that spending fell if you expected higher future inflation and the same if one thought that unemployment would be greater in the second location

The reviewed literature establishes that household inflation in Malaysia is influenced by a combination of macroeconomic, external, and behavioral factors. Key domestic determinants include money supply, interest rates, exchange rates, government expenditure, and housing prices, while global commodity price fluctuations and import dependency intensify inflationary pressures. At the household level, differences in income, debt exposure, and inflation expectations further explain variations in consumption behavior and vulnerability to price changes. Despite these extensive studies, there remains a gap in the use of artificial intelligence and data visualization tools to analyze inflation patterns dynamically and to provide evidence-based financial planning insights for different household income groups.

Therefore, this study aims to fill that gap by applying Python-based AI analytical techniques and interactive Power BI dashboards to identify, classify, and visualize household inflation patterns in Malaysia from 2020 to 2024. The approach seeks not only to uncover statistical relationships between key inflation factors and household expenditure but also to translate these findings into practical tools for financial decision-making and policy support.

### **3. METHODOLOGY**

The study carried out six phases of methodological framework to analyze household inflation determinants and develop practical financial insights for Malaysians. Each phase systematically explores data collection, key features identification, interactive dashboard construction, statistical analysis application, financial planning considerations, and assessment and interpretation using artificial intelligence tools. Based on previous studies, the key factors influencing household inflation in Malaysia are money supply, interest and exchange rates, government expenditure, housing prices, and global commodity prices. Additionally, behavioral factors are inflation expectations and consumption patterns contribute to household-level inflation responses. These determinants are analyzed in this study using data-driven techniques.

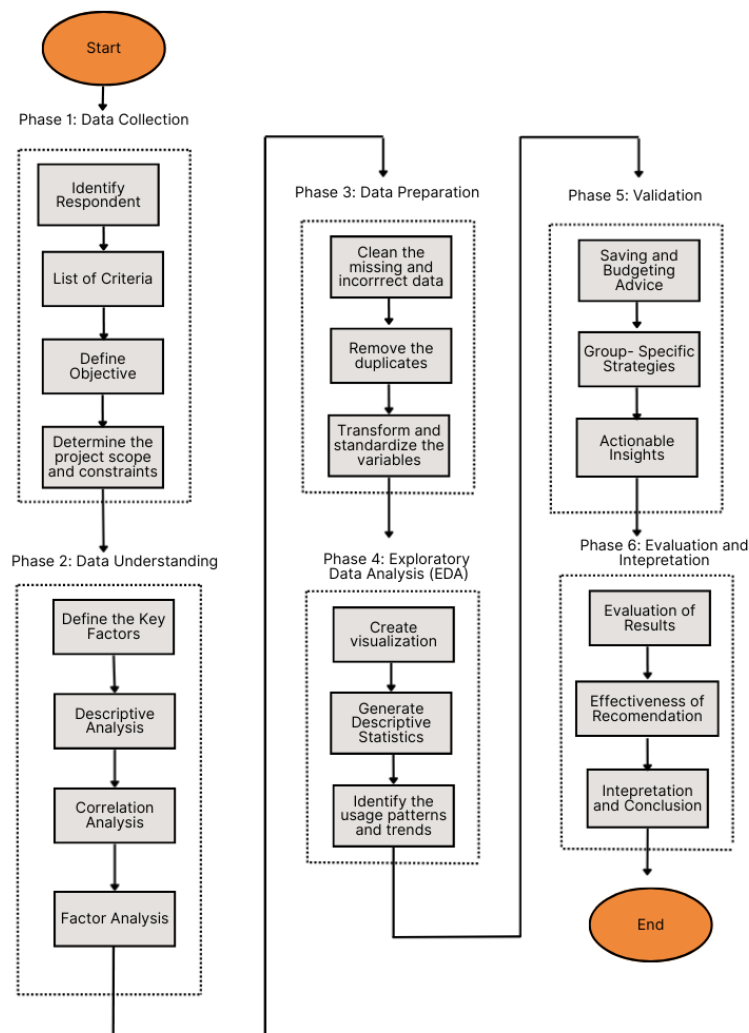


Figure 1. Flow chart of the methodology.

### Phase 1: Data Collection

The first stage involves collecting data from several reputable sources to obtain a comprehensive understanding of household inflation in Malaysia. Data sources on consumer price, income and household expenditure patterns are gathered from the Department of Statistics Malaysia (DOSM). Additional information on consumer inflation expectations is extracted from the Bank Negara Malaysia Consumer Sentiment Survey (BNM CSS). Global economic datasets are consulted for analysing the role of external trade-related shocks, in particular variations in food and energy prices, that influence Malaysian inflation. The last five years of data, 2020 – 2024 are examined to capture the latest trends and patterns in household inflation.

### Phase 2: Data Understanding

In this phase, the collected data are examined to identify the principal economic forces driving household-level inflation. This analysis is achieved through a thorough descriptive review in which data are summarised and inflationary trends identified. Descriptive and correlation analyses are employed to summarize inflationary trends and assess relationships among key variables including interest rate, exchange rate, housing prices, and household expenditure. Furthermore, factor analysis

is used to discover the common economic variables in which households' inflation originates, enabling more refined insights into their sources.

### Phase 3: Data Preparation

In Phase 3, an interactive dashboard is created to visually display the results in an accessible and engaging way. The dashboard is developed using data visualization software which is Power BI and enables users to analyse inflation trends and household spending patterns across different income categories (B40, M40 and T20). The dashboard incorporates options to visualise live data, compare inflation from current data set or through historical patterns and the comparison of spending patterns among income groups. It also includes filters that allow users to look at how inflation affects households in different regions and sectors, offering a more customized, dynamic way of analyzing inflation trends.

### Phase 4: Exploratory Data Analysis (EDA)

Exploratory Data Analysis (EDA) is conducted using Python to detect data irregularities such as outliers, skewness, or missing values. Visual tools such as histograms, boxplots, and scatter plots are utilized to identify patterns and relationships among variables. Histograms are used to examine the frequency distribution of a variable  $X = \{x_1, x_2, \dots, x_n\}$ , while boxplots summarize the data based on quartiles. In this study, scatter plots are also used to help identify potential connection between pairs of variables. The Python coding for the initial visualisation is as Figure 2:

```
import pandas as pd
import matplotlib.pyplot as plt

# Load dataset
data = pd.read_csv("data.csv")

# Histogram
data.hist(figsize=(10, 6))
plt.suptitle("Initial Distribution of Numerical Variables")
plt.show()

# Boxplot
plt.figure(figsize=(10, 6))
data.boxplot()
plt.title("Boxplot for Outlier Detection")
plt.xticks(rotation=45)
plt.show()
```

**Figure 2.** Python code for the initial visualization.

Descriptive analysis summarizes the main characteristics of the dataset using statistical measures. Central tendency is represented by the mean and median, while dispersion is measured using the standard deviation and range. These statistics provide insight into the typical behavior and variability of the data.

For a numerical variable  $X = \{x_1, x_2, \dots, x_n\}$ , the mean ( $\mu$ ) and standard deviation ( $\sigma$ ) are defined as:

$$\mu = \frac{1}{n} \sum_{i=1}^n x_i$$

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \mu)^2}$$

The range of the data is given by:

$$Range = \max(x) - \min(x)$$

The Python coding for descriptive analysis is given the Figure 3 below.

```
python

# Descriptive statistics
descriptive_stats = data.describe()
print(descriptive_stats)

# Check missing values
print("\nMissing Values:")
print(data.isnull().sum())
```

**Figure 3.** Python code for the descriptive statistics.

Usage patterns are identified by analyzing frequency distributions and relationships between variables. Frequently occurring values or categories indicate dominant usage behavior. Trends are observed by examining gradual changes or consistent patterns across the dataset. Correlation analysis is used to measure the strength and direction of linear relationships between numerical variables. The relative frequency of category  $i$  is given by:

$$f_i = \frac{n_i}{n}$$

where  $n_i$  is the number of observations in category  $i$ . The Pearson correlation coefficient between two variables  $X$  and  $Y$  is defined as:

$$\rho_{XY} = \frac{Cov(X, Y)}{\sigma_X \sigma_Y}$$

Values of  $\rho_{XY}$  close to 1 or -1 indicate strong trends, while values near 0 indicate weak or no linear relationship. The following Python code is used to analyze the correlation (see Figure 4).

```
python

# Frequency analysis for categorical variables
categorical_columns = data.select_dtypes(include=['object']).columns

for col in categorical_columns:
    print(f"\nFrequency distribution for {col}:")
    print(data[col].value_counts(normalize=True))

# Correlation matrix
correlation_matrix = data.corr()
print("\nCorrelation Matrix:")
print(correlation_matrix)
```

**Figure 4.** Python code for the correlation matrix.

#### Phase 5: Validation

From the insights of statistical analysis and the Interactive Dashboard, practical financial advice is presented to Malaysian households. Recommendations specifically address the importance of savings, the best strategies for budgeting and financial planning methods tailored to assisting households with responding to inflation. The advice would cater to the various income brackets (B40, M40, T20), which shall include specifics on effective ways and means of savings methods and to change lifestyle spending habits as well as how to prepare for future inflationary pains. It also gives practical advice to households who are now focused on building their financial resilience and dealing with the increased cost of living.

#### Phase 6: Evaluation and Interpretation

In the final phase, the results are examined to indicate the main determinants of household inflation and assess their varying impacts across income segments. The study also reflects on the effectiveness of the financial planning framework developed in Phase 5, examining its implications for household financial security. The insights coming out of this phase enable policy makers and financial institutions to develop more focused policies and services to assist households experiencing the pressures of inflation.

## 4. FINDINGS

The analysis of household inflation in Malaysia between 2020 and 2024 reveals several key patterns. The sharpest increase in inflation occurred in 2022, largely driven by global commodity price shocks and rising domestic housing costs. At the state level, the Consumer Price Index (CPI) indicates stronger inflationary pressures in urbanised areas such as Selangor, WP Kuala Lumpur, and Penang, reflecting both higher living costs and sustained demand in housing and services. External influences, including fluctuations in exchange rates, global food prices, and fuel costs, also contributed significantly to price instability during this period. Figure 5 shows the consumer price index for each state.

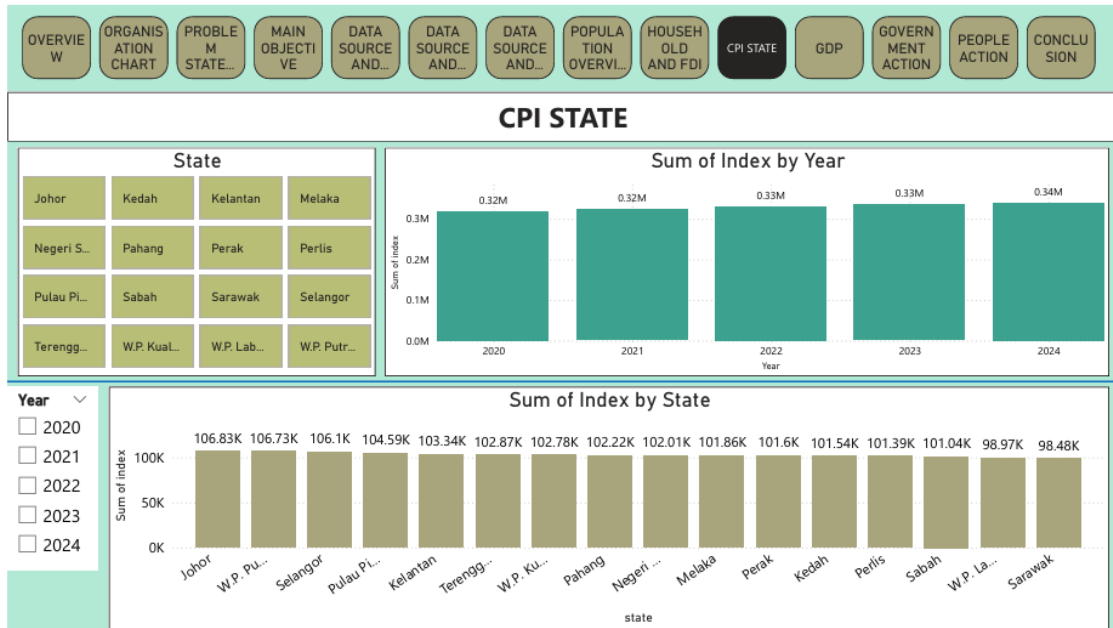


Figure 5. Consumer price index for each state.

The impact of inflation varies across income groups. The B40 and M40 households are the most vulnerable, as a larger share of their expenditure is concentrated on essential categories such as food and housing. In contrast, T20 households remain relatively insulated due to their higher disposable incomes and more diversified consumption patterns. From a broader perspective, GDP and GNI data indicate economic recovery following the pandemic, but the inflationary surge during 2021–2022 eroded real purchasing power, particularly among lower- and middle-income households. At the same time, fluctuations in foreign direct investment (FDI) inflows indirectly influenced inflation dynamics through investment-driven demand in selected states. Figure 6 shows the gross domestic product.

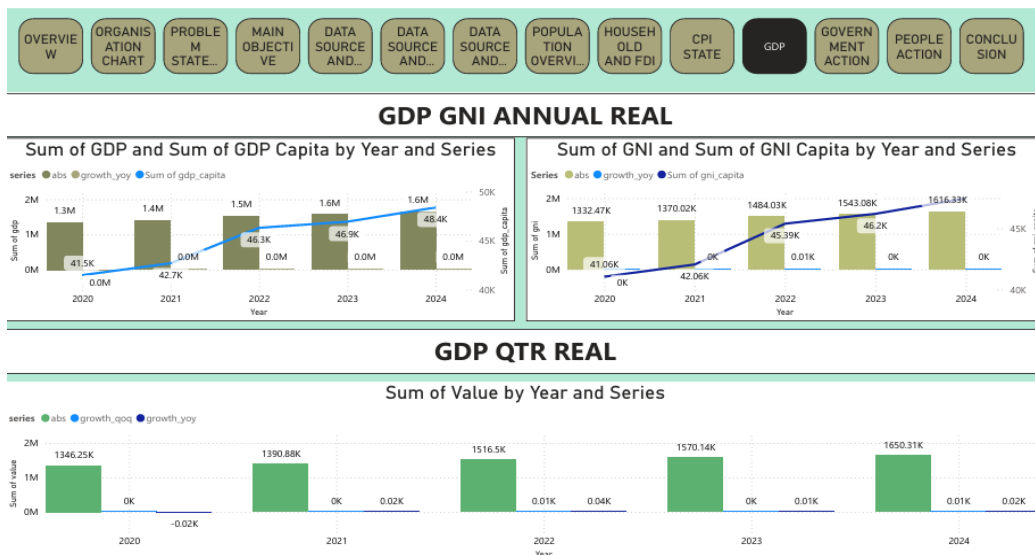


Figure 6. Gross domestic product.

This study produces several important outputs. First, an interactive Power BI dashboard has been developed to visualise CPI, GDP, and household expenditure trends from 2020 to 2024. The dashboard enables users to track inflation patterns across time, compare impacts between states, and

assess differences among income groups. Its interactive features allow households to simulate expenditure scenarios under varying inflation levels, making it a practical tool for financial planning. Figure 7 and 8 show the population overview and household and FDI flows, respectively.

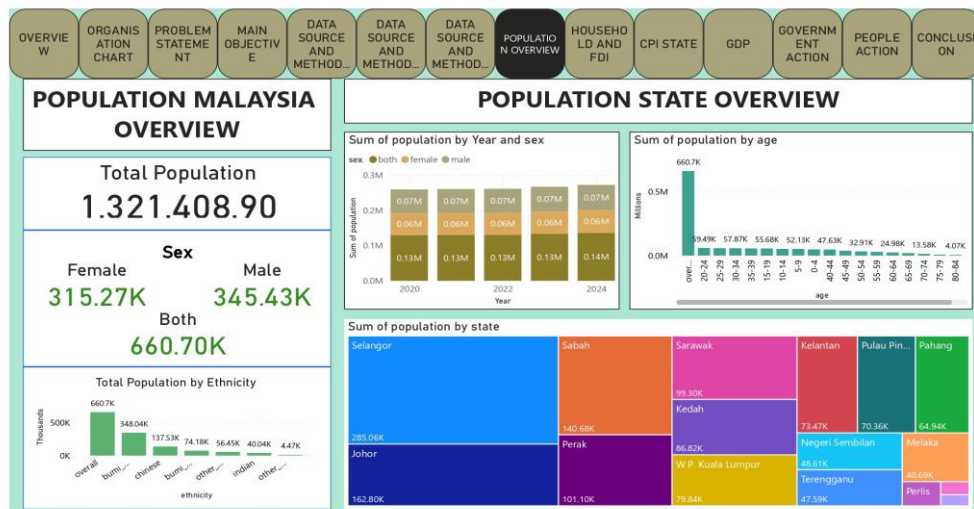


Figure 7. Population overview.

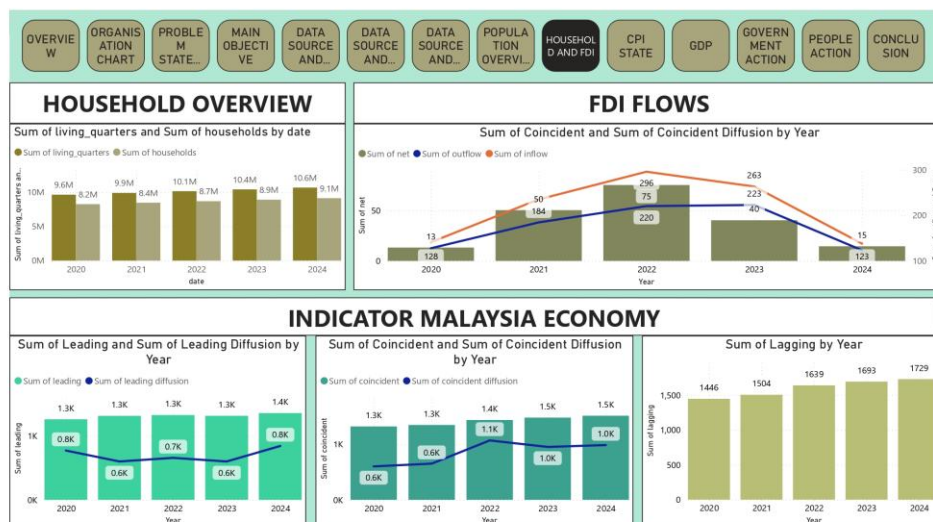


Figure 8. Household and FDI flows.

Second, the study provides empirical insights through different analytical approaches. Descriptive analysis highlights national and state-level inflation trends, while correlation analysis identifies the relationships between inflation and key economic variables such as household income, expenditure structures, housing prices, and exchange rates. Factor analysis further refines these insights by grouping inflation drivers into three categories: domestic cost-of-living pressures, external shocks, and monetary or financial conditions.

Finally, the outputs contribute both academic and practical value. For households, the dashboard serves as a guide to develop customised budgets that account for inflation risks. For policymakers, the findings offer evidence-based insights into the vulnerability of different income groups and regions, thereby supporting the design of more targeted interventions to mitigate the effects of inflation.

## 5. CONCLUSION

This study successfully achieved its primary objectives of identifying key factors influencing household inflation in Malaysia, visualizing inflation trends through an interactive Power BI dashboard, and providing data-driven financial planning tools tailored to different income groups. Using artificial intelligence and statistical analysis, the research revealed that domestic cost-of-living pressures, external commodity price fluctuations, and monetary conditions jointly shape inflationary patterns between 2020 and 2024.

The integration of Python-based analytics and business intelligence visualization not only enhances the interpretability of inflation trends but also offers a practical framework for households to strengthen financial resilience through informed budgeting and savings strategies. For policymakers, these findings deliver actionable insights into income group vulnerabilities and regional disparities in inflation exposure, supporting the design of targeted interventions to ease the cost of living.

Future research should consider extending this framework by integrating predictive analytics and machine learning forecasting to anticipate inflation dynamics under varying economic scenarios. Broader datasets, including behavioral and sentiment-based indicators, may further enrich the analysis and improve household-level policy simulations. Overall, this study contributes both theoretical and practical value by demonstrating how AI-driven analytics can translate complex economic data into accessible, actionable tools for financial well-being.

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