A Multi-Criteria Decision-Making Model for Prioritizing the Causes of Inflation in Libya Using the Best-Worst Method and Analytic Hierarchy Process

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ARTICLE INFO	ABSTRACT
	Inflation remains one of the most persistent and destabilizing economic challenges facing Libya, affecting purchasing power, investment, and overall economic stability. Understanding its root causes is essential for designing effective and targeted policy interventions. This study investigates the main drivers of inflation in Libya by applying a hybrid Multi-Criteria Decision-Making (MCDM) approach that combines the Best-Worst Method (BWM) and the Analytic Hierarchy Process (AHP). Eight critical inflation-related factors were identified through expert consultations and economic literature, including structural, monetary, and institutional elements. The BWM was first used to determine initial weight coefficients by comparing the most and least influential factors, followed by the AHP to conduct comprehensive pairwise comparisons. The final weights were derived by aggregating the results from both methods to ensure robustness and consistency. The findings indicate that weak domestic production and political instability are the most significant contributors to inflation in Libya, followed by currency devaluation and monetary expansion. These results emphasize the need for integrated policy responses that not only address monetary dynamics but also confront deeper structural constraints. The study offers a transparent and replicable framework for inflation analysis and contributes to more informed and context-specific economic policymaking in fragile and transitional economies.

1. Introduction

Inflation is a persistent rise in the general price level of goods and services in an economy over a period of time, resulting in the erosion of purchasing power [1]. It represents one of the most closely watched economic indicators, as it affects nearly every aspect of an economy—from household consumption and business investment to monetary policy and exchange rates. Economists distinguish between different types of inflation, such as demand-pull, cost-push, and built-in

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inflation, each driven by unique forces. Regardless of the type, sustained inflation can distort economic signals, complicate planning and forecasting, and deepen income inequality. Understanding its causes and structure is thus crucial for governments, financial institutions, and policymakers aiming to maintain economic stability and promote growth [2].

The importance of studying inflation lies in its wide-ranging effects on both macroeconomic performance and individual well-being. Moderate inflation can be a sign of healthy economic activity, but high or unpredictable inflation can destabilize economies, reduce savings, and undermine investor confidence [3, 4]. In response, policymakers seek to identify and prioritize the root causes of inflation to design more effective monetary and fiscal interventions. Given the complex interplay of domestic and external factors contributing to inflationary pressures, quantitative approaches such as Multi-Criteria Decision-Making (MCDM) models offer valuable tools for systematically analyzing these causes and assisting in policy formulation [5].

Libya provides a particularly interesting case for the study of inflation, given its volatile economic history and prolonged periods of political instability. As an oil-dependent economy, Libya's fiscal and monetary health is strongly influenced by fluctuations in global oil prices [6]. For decades, public revenues have been closely tied to hydrocarbon exports, making the economy vulnerable to external shocks. Additionally, Libya's heavily subsidized system, large public sector employment, and dependence on imports for food and consumer goods have further compounded structural weaknesses. The combination of these factors has had significant implications for inflationary dynamics in the country [7].

Over the past decade, Libya has experienced profound disruptions that have deeply affected its economic foundations. The political conflict and institutional fragmentation that followed the 2011 revolution have led to the deterioration of central governance and reduced the state's capacity to regulate prices, control monetary supply, and stabilize exchange rates [8]. Multiple exchange rates, black market activity, and periodic liquidity crises have contributed to price volatility and eroded public trust in economic institutions. Episodes of sharp currency devaluation, driven by both market forces and policy interventions, have directly translated into rising costs of imports and inflationary pressure across sectors.

Inflation in Libya has not only been a reflection of macroeconomic imbalances but also of more complex socio-political realities. The country's weak domestic production base, damaged infrastructure, and limited access to financial markets have all constrained economic recovery and increased reliance on imports. While several studies have documented the evolution of inflation in Libya, there remains a lack of structured analysis identifying and ranking its underlying causes. Given the overlapping influences of fiscal, monetary, institutional, and external factors, there is a need for a comprehensive, data-driven framework to support evidence-based policy responses.

This paper aims to identify, evaluate, and prioritize the key causes of inflation in Libya using a hybrid Multi-Criteria Decision-Making approach that integrates the Best-Worst Method (BWM) and the Analytic Hierarchy Process (AHP). By consulting expert judgment and applying a structured weighting methodology, the study provides a ranked list of inflation drivers based on their relative importance. This approach supports the formulation of targeted policies and interventions to address inflation effectively. The findings are intended to assist policymakers, economists, and stakeholders in understanding the multifaceted nature of inflation in Libya and in designing responsive strategies tailored to its unique economic context.

2. Literature review

The theoretical foundation for understanding inflation has evolved beyond traditional monetary explanations to include political and structural dimensions. Recent models emphasize the importance of factors such as political stability, policy credibility, and institutional quality in shaping inflationary patterns [9]. This broader perspective recognizes that inflation is not solely a monetary phenomenon but often reflects deeper systemic challenges [10]. In developing economies, where governance constraints and market inefficiencies persist, these structural issues can intensify inflation through disrupted production systems, weak fiscal discipline, and inadequate regulatory frameworks.

Numerous empirical studies confirm that money supply plays a significant role in influencing inflation, particularly in emerging and transitional economies. Research conducted using a range of econometric models has shown both short- and long-term associations between monetary expansion and rising price levels [11]. In countries where fiscal deficits are monetized, excessive liquidity in the market has been linked to persistent inflationary pressures. Recent findings based on ARDL models further validate the impact of monetary aggregates while also highlighting the relevance of additional macroeconomic variables such as interest rates and unemployment [12].

Despite strong evidence linking money supply to inflation, several studies have pointed out the limitations of relying exclusively on monetary indicators. Other factors such as import dependency, supply-side disruptions, and fluctuations in energy prices have also been identified as critical drivers of inflation [13]. This suggests that addressing inflation effectively requires an integrated policy approach that incorporates institutional, structural, and fiscal reforms. A purely monetary response may be insufficient if not accompanied by improvements in production capacity, political stability, and regulatory clarity. This reinforces the value of multi-criteria evaluation frameworks that can incorporate and weigh diverse inflationary influences in complex and uncertain environments [12].

3. Methodology

In complex decision-making environments, especially those involving multiple conflicting criteria, MCDM methods have proven to be effective tools for supporting structured, transparent, and rational evaluations [14, 15]. These methods are increasingly used across a wide range of domains, including supply chain management SCM [16, 17], energy planning [18, 19], environmental assessment [20], and economic policy analysis [21]. In the context of economics, MCDM techniques are particularly valuable for analyzing multifactorial issues such as inflation, where various drivers interact under uncertain and dynamic conditions. By enabling the systematic comparison and prioritization of alternatives or influencing factors, MCDM models provide a practical framework for informed decision-making.

Most prior studies addressing inflation in the Libyan context have focused primarily on monetary variables, such as money supply, exchange rate fluctuations, and government spending, often using econometric models or time-series analysis. While these approaches provide valuable insights into

macroeconomic correlations, they often overlook structural and institutional dimensions such as weak domestic production, political instability, and regulatory inefficiencies [22-24].

In this study, an integrated multi-criteria decision-making approach is proposed to evaluate and prioritize the causes of inflation in Libya. The model is based on two primary components: (1) the application of the Best-Worst Method (BWM) and the Analytic Hierarchy Process (AHP) to determine the weighting coefficients of the identified inflation drivers, and (2) the aggregation of these weights through arithmetic averaging to produce a final set of normalized criteria weights. The hybrid BWM-AHP framework is structured in two phases [25, 26]. In the first phase, BWM is used to efficiently determine the initial weights by identifying the most and least influential criteria, thus minimizing the number of pairwise comparisons and ensuring consistency. In the second phase, AHP is employed to refine the judgment process through a broader set of comparisons, after which the weights from both methods are aggregated using a simple arithmetic mean. This integrated approach leverages the strengths of both BWM and AHP while mitigating their individual limitations, providing a balanced and objective evaluation of the relative importance of inflation causes. The use of this hybrid methodology allows for a more nuanced understanding of the economic context in Libya and facilitates informed policymaking by enabling a clear ranking of contributing factors.

The proposed multi-criteria framework represents one of the first mathematical models in the literature that applies an integrated BWM-AHP approach to the evaluation of inflation causes, specifically within the context of the Libyan economy. By introducing this hybrid model to the study of macroeconomic issues such as inflation, the research contributes to the development of methodological advancements in the field of economic decision-making. The authors believe that presenting this integrated multi-criteria concept will enrich the existing literature by offering a structured and objective means of prioritizing inflation drivers. This can support policymakers in designing more effective and targeted interventions based on a systematic understanding of the relative impact of each factor.

3.1 Determining weight coefficients using the BWM

The Best-Worst Method (BWM) is a relatively recent Multi-Criteria Decision-Making (MCDM) technique designed to address several limitations associated with earlier methods. One of its key advantages lies in the reduced number of pairwise comparisons required, which not only minimizes the burden on experts but also improves the consistency of judgments [27]. Compared to traditional methods such as AHP, BWM generates results that are generally more reliable, stable, and logically coherent. These characteristics make it particularly suitable for policy-oriented applications, such as identifying the most influential causes of inflation. The pseudo code for implementing the BWM algorithm is presented in Figure 1.

Input: Set of criteria C = {c1, c2, ..., cn}

Step 1: Determine the Best (B) and Worst (W) criteria from C

→ Vector AB = [aB1, aB2, ..., aBn], where aBB = 1

Step 2: Determine the preference of the Best criterion over all other criteria

Step 3: Determine the preference of all other criteria over the Worst criterion

→ Vector AW = [a1W, a2W, ..., anW], where aWW = 1

Step 4: Formulate and solve the following optimization model:

Minimize ξ

Subject to:

$|w_B / w_j - a_{Bj}| \leq \xi$ for all j

$|w_j / w_W - a_{jW}| \leq \xi$ for all j

$\sum w_j = 1$

$w_j \geq 0$ for all j

Step 5: Obtain optimal weights w* = [w1, w2, ..., wn]

→ These represent the final BWM weights of the criteria

Output: Criteria weights w*

3.2 Determining weight coefficients using the AHP model

The Analytic Hierarchy Process (AHP) is one of the most widely used techniques in multi-criteria decision-making, particularly effective in determining the relative importance—or weights—of evaluation criteria. Its popularity stems from its structured methodology, which allows decision-makers to perform pairwise comparisons among criteria, enabling a systematic assessment of both qualitative and quantitative factors. AHP's flexibility makes it applicable across various fields, including economics, engineering, and policy analysis. In this study, the AHP model is employed to complement the BWM method by incorporating subjective expert judgments to refine the weighting process. These judgments are used to construct a consistent comparison matrix, ultimately yielding a set of normalized weights that reflect the perceived importance of each inflation driver in the Libyan context [28].

4. Application of the Hybrid BWM-AHP Model for Determining Weight Coefficients of Inflation Causes in Libya

In this study, a hybrid BWM-AHP model is applied to determine the weighting coefficients of the main causes contributing to inflation in Libya. The objective of this integrated approach is to combine the consistency and efficiency of the Best-Worst Method (BWM) with the depth and robustness of the Analytic Hierarchy Process (AHP). This two-phase model begins with the application of BWM, in which experts identify the most and least significant inflation factors and provide comparative judgments. In the second phase, the AHP method is used to refine the analysis by conducting pairwise comparisons among all factors. The weights obtained from both methods are then aggregated using arithmetic averaging to produce a final set of normalized weights. These weights represent the relative importance of each inflation driver and form the basis for further evaluation and policy prioritization. By integrating BWM and AHP, the model provides a more balanced and reliable estimation of criteria importance, ensuring that both consistency and subjective expert knowledge are adequately captured. Table 1 shows the criteria used in this research.

Table 1

Criteria for the evaluation of inflation causes

Criteria		Description
C1	Currency Devaluation	Depreciation of the Libyan dinar increases import costs, leading to higher prices for goods and services.
C2	Import Dependency	Reliance on imported goods makes the economy vulnerable to external price changes and supply shocks.
C3	Public Sector Wage Expansion	Increases in public sector salaries stimulate demand and contribute to demand-pull inflation.
C4	Monetary Expansion	Excess liquidity and expansionary monetary policies reduce the value of money and trigger inflation.
C5	Fuel Subsidies and Smuggling	Subsidies create market distortions, while fuel smuggling reduces supply and adds to price pressures.
C6	Political Instability and Conflict	Ongoing conflict disrupts production, distribution, and regulatory frameworks, raising costs.
C7	Weak Domestic Production	Limited local manufacturing and agriculture result in supply shortages and increased reliance on costly imports.
C8	Black Market & Parallel Exchange Rates	Multiple exchange rates create uncertainty and lead to inconsistent pricing and inflationary trends.

To support the weighting process within the hybrid BWM-AHP model, this study engaged four experts who contributed to both phases of the evaluation. In the first phase, the experts identified the most and least influential causes of inflation in Libya and provided the necessary pairwise comparisons for the BWM analysis. In the second phase, the same experts completed the AHP comparison matrices to assess the relative importance of each criterion more comprehensively. Their contributions were critical in producing consistent and well-informed weight coefficients, ensuring that the final results reflect a balanced and expert-driven perspective on the key drivers of inflation within the Libyan economic context.

4.1 Determining weight coefficients using the BWM

The process of determining the weight coefficients using the BWM begins by identifying the most important (Best) criterion and the least important (Worst) criterion among the set of alternatives. Once the Best (B) and Worst (W) criteria are selected, two vectors are constructed: the Best-to-Others (BO) vector, which reflects the preference of the Best criterion over all other criteria, and the Others-to-Worst (OW) vector, which reflects the preference of all criteria over the Worst criterion. The values of the BO and OW vectors provided by the experts are presented in Table 2.

Table 2
Evaluation vectors

Criteria			
Best: C6	Expert evaluation	Worst: C5	Expert evaluation

C1	2;2;3;1	C1	3;3;3;3
C2	3;3;3;4	C2	2;3;2;2
C3	3;5;3;2	C3	2;2;2;2
C4	2;2;2;3	C4	3;4;3;4
C5	5;4;4;5	C6	5;4;6;4
C7	1;1;1;1	C7	5;4;3;4
C8	3;2;2;3	C8	2;2;2;2

The Best-to-Others (BO) vector, presented in Table 2, reflects expert preferences indicating the relative advantage of the selected Best criterion (C6) over the other criteria within the defined set. To express these preferences, a numerical scale was employed, where higher values denote a greater perceived importance of criterion C6 compared to criterion *j*. Similarly, the Others-to-Worst (OW) vector captures the advantage of each criterion *j* over the designated Worst criterion (C5), using the same preference scale. In this case, higher values represent a stronger preference for criterion *j* relative to the worst-performing criterion, thus providing a structured basis for calculating the final weight coefficients.

After calculating the average BO and OW vectors, the average values of the BP and OW vectors are obtained using the expression for the arithmetic averaging of the numbers $x_{ij} = (1/n)\sum_{i=1}^{n} x_i$.

The optimal weight coefficients of the criteria are computed by solving a mathematical model that utilizes the BO and OW vectors provided by expert evaluations. These vectors capture the relative preferences of the Best criterion over all others, and of all criteria over the Worst criterion, respectively. The calculation of the optimal weights is performed using the following optimization equation, which ensures consistency across the pairwise comparisons.

$$\min \xi$$
$$s.t.$$
$$\left| \frac{w_B}{w_j} - a_{Bj} \right| \leq \xi, \forall j$$
$$\left| \frac{w_j}{w_w} - a_{jW} \right| \leq \xi, \forall j$$
$$\sum_{j=1}^{n} w_j = 1$$
$$w_j \geq 0 \quad \forall j$$

Table 3 shows the optimal weight coefficient values based on the above model.

Table 3
Optimal criterion values – BWM

Criteria	Weights	Rank

C1	Currency Devaluation	0.122	3
C2	Import Dependency	0.082	5
C3	Public Sector Wage Expansion	0.082	6
C4	Monetary Expansion	0.122	4
C5	Fuel Subsidies and Smuggling	0.044	8
C6	Political Instability and Conflict	0.233	1
C7	Weak Domestic Production	0.233	2
C8	Black Market & Parallel Exchange Rates	0.082	7

The results presented in the table reflect the weights and rankings of the inflation causes as determined by the BWM method. According to expert evaluations, Political Instability and Conflict (C6) and Weak Domestic Production (C7) emerged as the most influential factors, each receiving the highest weight of 0.233. In contrast, Fuel Subsidies and Smuggling (C5) was considered the least significant, with a weight of 0.044. These weights provide an initial insight into the relative importance of each criterion. In the next phase of the analysis, the AHP will be applied to calculate another set of weights for the same criteria, which will later be integrated with the BWM results to obtain final weight coefficients.

4.2 Determining weight coefficients using the AHP model

After expert comparisons in the pair of criteria, four comparison matrices were obtained for the experts, Table 4.

Table 4
Expert comparisons in pairs of criteria

Expert 1									Expert 2							
	C1	C2	C3	C4	C5	C6	C7	C8		C1	C2	C3	C4	C5	C6	C7	C8
C1	1	4	1	2	2	1	1	1	C1	1	2	2	2	9	1	1	1
C2	0.25	1	0.25	0.5	0.5	0.2	0.16	0.33	C2	0.5	1	1	1	9	0.5	0.5	1
C3	1	4	1	2	2	1	1	2	C3	0.5	1	1	1	8	0.33	0.33	0.5
C4	0.5	2	0.5	1	1	0.5	0.33	0.5	C4	0.5	1	1	1	9	0.5	0.5	1
C5	0.5	2	0.5	1	1	0.5	0.33	0.5	C5	0.11	0.11	0.12	0.11	1	0.11	0.11	0.11
C6	1	5	1	2	2	1	1	2		1	2	3	2	9	1	1	2
C7	1	6	1	3	3	1	1	2		1	2	3	2	9	1	1	2
C8	1	3	0.5	2	2	0.5	0.5	1	C6	1	1	2	1	9	0.5	0.5	1
Expert 3									Expert 4							
	C1	C2	C3	C4	C5	C6	C7	C8		C1	C2	C3	C4	C5	C6	C7	C8

C1	1	9	2	2	9	0.5	0.5	1	C1	1	1	1	0.5	4	0.33	0.5	4
C2	0.11	1	0.11	0.11	1	0.11	0.11	0.11	C2	1	1	1	0.33	3	0.33	0.33	3
C3	0.5	9	1	1	9	0.33	0.33	1	C3	1	1	1	0.5	5	0.5	0.5	4
C4	0.5	9	1	1	9	0.33	0.33	1	C4	2	3	2	1	9	1	1	8
C5	0.11	1	0.11	0.11	1	0.11	0.11	0.11	C5	0.25	0.33	0.2	0.11	1	0.11	0.11	1
C6	2	9	3	3	9	1	1	2		3	3	2	1	9	1	1	9
C7	2	9	3	3	9	1	1	2		2	3	2	1	9	1	1	8
C8	1	9	1	1	9	0.5	0.5	1	C6	0.25	0.33	0.25	0.12	1	0.11	0.12	1

Following the pairwise comparison of the criteria, the consistency ratio (CR) for each expert's comparison matrix was calculated to ensure the reliability of the judgments. A consistency ratio below 0.10 is generally considered acceptable in AHP analysis, indicating that the judgments are logically consistent. As shown in Table 5, all CR values are less than 0.10, confirming the validity of the expert inputs.

Table 5
CR and weight values

Expert	*CR*
E1	0.009
E2	0.017
E3	0.028
E4	0.004

Table 6 shows the final values of the criterion weight coefficients based on the elements of the aggregated matrix of criteria pairwise comparisons.

Table 6
Final criterion weights using AHP model

Criteria		Weights	Rank
C1	Currency Devaluation	0.144	3
C2	Import Dependency	0.060	7
C3	Public Sector Wage Expansion	0.117	5
C4	Monetary Expansion	0.125	4
C5	Fuel Subsidies and Smuggling	0.033	8
C6	Political Instability and Conflict	0.210	2
C7	Weak Domestic Production	0.212	1

	Black Market & Parallel Exchange Rates		
C8		0.099	6

Table 7 presents the final criteria weight values, which will be used to evaluate and compare the relative significance of the identified causes of inflation in Libya.

Table 7
Final values of the criteria weights

Criteria		BWM	AHP	Final weights	Rank
C1	Currency Devaluation	0.122	0.144	0.133	3
C2	Import Dependency	0.082	0.060	0.071	7
C3	Public Sector Wage Expansion	0.082	0.117	0.099	5
C4	Monetary Expansion	0.122	0.125	0.123	4
C5	Fuel Subsidies and Smuggling	0.044	0.033	0.038	8
C6	Political Instability and Conflict	0.233	0.210	0.222	2
C7	Weak Domestic Production	0.233	0.212	0.223	1
C8	Black Market & Parallel Exchange Rates	0.082	0.099	0.091	6

The integrated results of the BWM and AHP methods offer a comprehensive understanding of the most influential drivers of inflation in Libya. By averaging the weights obtained from both models, the analysis presents a balanced view that combines the consistency and simplicity of BWM with the detailed comparative structure of AHP. The findings clearly highlight Weak Domestic Production (C7) and Political Instability and Conflict (C6) as the two most critical causes of inflation, receiving the highest final weights of 0.223 and 0.222, respectively. These results underscore the structural and institutional challenges facing Libya's economy. The dominance of C7 reflects the country's heavy reliance on imports for essential goods and its limited capacity for local production. Without a stable and functioning industrial base, price fluctuations in global markets are quickly transmitted to domestic prices, increasing inflationary pressures. Similarly, the high weight assigned to Political Instability and Conflict (C6) aligns with the reality that Libya's fragmented political landscape and recurrent conflict have severely disrupted supply chains, weakened state institutions, and limited the effectiveness of monetary and fiscal policies. These conditions foster market inefficiencies, reduce investor confidence, and contribute to uncertainty, all of which exacerbate inflationary trends.

Currency Devaluation (C1) and Monetary Expansion (C4) follow as the next most influential factors. Their prominence confirms the critical role of monetary policy and exchange rate management in inflation dynamics. The depreciation of the Libyan dinar has consistently led to rising import costs, while excess liquidity in the economy—fueled by government spending and weak monetary control—has increased demand without corresponding supply, pushing prices upward. Interestingly, Public Sector Wage Expansion (C3) also appears as a moderately important factor. While it supports household income and consumption, unchecked increases in public wages can lead to demand-pull inflation, especially in an economy with limited production capabilities.

5. Conclusion

This study applied a hybrid BWM and AHP model to identify and prioritize the key drivers of inflation in Libya. By incorporating the judgments of multiple experts and combining the strengths of both decision-making methods, the study provides a robust and structured assessment of the most influential inflationary factors affecting the Libyan economy.

The results demonstrate that Weak Domestic Production and Political Instability and Conflict are the most critical contributors to inflation, underscoring the structural and institutional challenges that must be addressed to achieve long-term price stability. Other significant factors include Currency Devaluation and Monetary Expansion, reflecting the importance of sound monetary and exchange rate policies. Lower-ranked causes such as Fuel Subsidies and Smuggling and Import Dependency were identified as secondary influences, though still relevant in shaping the overall inflationary environment.

The integrated weighting approach used in this study not only improves the reliability of the findings but also enhances the decision-making process for policymakers. The insights gained can inform the design of targeted economic reforms aimed at stabilizing prices, strengthening local production, and improving macroeconomic resilience. Future research may build on this work by integrating time-series data or extending the analysis to evaluate potential policy interventions using complementary MCDM methods. The analysis relies on expert judgment, which—despite being structured and methodologically supported—may still carry subjective bias or reflect limited perspectives based on the experts' backgrounds. In future studies, recent fuzzy sets and related AHP [21] and BWM [22] would be adopted.

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Conceptualization, I.B., Q.Y and M.B.; methodology, I.B., and W.Q; validation, M.B. and Q.Y.; formal analysis, M.B, W.Q and I.B.; writing—original draft preparation, I.B., Q.Y and W.Q; writing—review and editing, M.B.; visualization, M.B. and Q.Y; project administration, I.B. All authors have read and agreed to the published version of the manuscript.

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