

Digital Demand Signals for Global Halal Business Markets: A Search Analytics–Based Opportunity Index

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Keywords:	ABSTRACT
Global Halal Industry; Search Engine Analytics; Google Trends; Composite Index; Machine Learning	Digital search behavior has emerged as a valuable source of market intelligence capable of capturing consumer interest before it is reflected in conventional economic indicators. However, existing studies on the halal industry remain fragmented, predominantly focusing on individual sectors without providing a comprehensive framework for evaluating global market opportunities. This study develops the Global Halal Industry Opportunity Index (GHIOI) by integrating search engine analytics and machine learning to assess digital halal market opportunities across 250 countries and territories. Weekly Google Trends data from 2019–2025 covering Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance were transformed into a multidimensional composite index and analyzed using K-Means clustering. The findings reveal considerable cross-country heterogeneity, with Brunei, Maldives, Singapore, and Malaysia exhibiting the strongest digital opportunity profiles. The clustering results further distinguish countries into high-, emerging-, and developing-opportunity groups, providing a more nuanced understanding of global halal market dynamics. By converting digital search signals into a composite measurement framework, GHIOI offers a leading indicator that complements conventional economic statistics. The proposed framework advances digital business and Islamic economics research while providing evidence-based market intelligence for policymakers, investors, exporters, and halal industry practitioners.
Kata Kunci:	ABSTRAK
Industri Halal Global; Google Trends; Analisis Pencarian Digital; Indeks Peluang Pasar; Pembelajaran Mesin	Perilaku pencarian digital telah menjadi sumber intelijen pasar yang mampu menangkap minat konsumen sebelum tercermin dalam indikator ekonomi konvensional. Namun, penelitian mengenai industri halal masih didominasi oleh analisis sektoral dan belum menyediakan kerangka pengukuran yang komprehensif untuk mengevaluasi peluang pasar halal secara global. Penelitian ini mengembangkan <i>Global Halal Industry Opportunity Index</i> (GHIOI)

dengan mengintegrasikan analisis mesin pencari dan pembelajaran mesin untuk menilai peluang pasar halal digital di 250 negara dan wilayah. Data mingguan Google Trends periode 2019–2025 yang mencakup Halal Food, Halal Cosmetics, Halal Tourism, dan Islamic Finance diolah menjadi indeks komposit multidimensi, kemudian dianalisis menggunakan algoritma K-Means. Hasil penelitian menunjukkan adanya heterogenitas yang signifikan antarnegara, dengan Brunei, Maladewa, Singapura, dan Malaysia memiliki profil peluang digital tertinggi. Analisis kluster selanjutnya mengelompokkan negara ke dalam kategori peluang tinggi, berkembang, dan potensial sehingga memberikan pemahaman yang lebih komprehensif mengenai dinamika pasar halal global. Dengan mentransformasikan sinyal pencarian digital menjadi kerangka pengukuran komposit, GHIOI berfungsi sebagai indikator awal yang melengkapi statistik ekonomi konvensional serta menawarkan informasi strategis bagi pembuat kebijakan, investor, eksportir, dan pelaku industri halal.

INTRODUCTION

The halal industry has emerged as one of the fastest-growing sectors of the global economy, extending far beyond its traditional association with food products to encompass pharmaceuticals, cosmetics, modest fashion, Muslim-friendly tourism, logistics, media, and Islamic financial services. This expansion has been driven by the rapid growth of the global Muslim population, increasing purchasing power, rising awareness of halal assurance, and broader consumer preferences for products that emphasize safety, quality, ethical production, and sustainability (DinarStandard, 2025). Consequently, the halal industry is increasingly recognized not merely as a religious market but as a strategic component of the global economic system with significant implications for international trade, investment, and sustainable development.

According to the *State of the Global Islamic Economy Report 2024/2025*, Muslim consumer expenditure across major halal sectors reached approximately US\$2.43 trillion in 2023 and is projected to increase to US\$3.36 trillion by 2028. During the same period, Islamic financial assets are expected to exceed US\$7.5 trillion, indicating that the halal economy continues to expand despite persistent global economic uncertainty (DinarStandard, 2025). Importantly, the growth of the halal industry is no longer concentrated in Muslim-majority countries. Increasing demand has also been observed across Europe, North America, East Asia, and Latin America, reflecting the globalization of halal consumption and the emergence of new international markets.

The digital transformation of consumer behaviour has fundamentally changed how individuals search for information, evaluate alternatives, and make purchasing decisions. Before purchasing halal products or services, consumers increasingly rely on online search engines to compare products, verify halal certification, obtain travel information, or explore Islamic financial services. Consequently, search engine queries represent consumers' information-search behaviour at the earliest stage of the decision-making process and

provide valuable digital traces of emerging market demand. Compared with conventional economic statistics, which generally become available after economic activities have occurred, search engine data offer near real-time information that may function as an early indicator of future market developments (Choi & Varian, 2012).

The growing availability of digital trace data has encouraged researchers to utilize Google Trends and other search engine analytics for monitoring economic activities, forecasting consumer demand, analysing tourism flows, predicting financial market behaviour, and identifying emerging consumption patterns (Choi & Varian, 2012; D'Amuri & Marcucci, 2017; Jun et al., 2018). Recent bibliometric evidence further indicates that digital and data-driven analytical approaches are becoming increasingly prominent in economics and business research, reflecting a broader shift toward evidence-based decision-making supported by large-scale digital datasets (Kadir et al., 2025). Within the context of the halal industry, recent studies have demonstrated that search engine data can effectively capture public interest in halal cosmetics, skincare products, and other halal-related topics, thereby providing alternative insights into consumer behaviour that are often unavailable through conventional datasets (Koswara & Herlina, 2025). These findings suggest that digital search behaviour has considerable potential to support evidence-based decision-making within the halal economy.

Recent studies have further expanded the application of digital trace data beyond forecasting toward strategic market intelligence and consumer analytics. Search engine data have been increasingly utilized to identify emerging consumption patterns, monitor public attention, and support evidence-based business decision-making in rapidly evolving markets (Hözl et al., 2025; Gummer & Oehrlein, 2025). Recent methodological research also emphasizes that, despite inherent measurement limitations, Google Trends remains a valuable source of high-frequency behavioural data when combined with appropriate normalization and validation procedures (Liu, 2024). Within the halal economy, however, empirical studies remain largely fragmented, focusing on individual sectors such as halal cosmetics, halal tourism, or Islamic finance rather than evaluating the halal ecosystem as an integrated global market (Putera & Rakhel, 2023). Moreover, existing assessments of halal market performance continue to rely predominantly on macroeconomic indicators, trade statistics, or certification measures that reflect realized market outcomes instead of emerging digital demand (DinarStandard, 2025; Greco et al., 2019). Consequently, there remains limited research that transforms digital search behaviour into a standardized composite indicator capable of comparing halal market opportunities across countries. This study addresses that gap by proposing the Global Halal Industry Opportunity Index (GHIOI), which integrates search engine analytics into a multidimensional framework for cross-country opportunity assessment.

Nevertheless, existing studies remain fragmented in several respects. First, most previous studies concentrate on specific halal sectors, such as halal cosmetics, halal food, or Muslim-friendly tourism, rather than examining the halal industry as an integrated global ecosystem. Second, the majority of studies employ descriptive analyses of search trends without translating digital search behaviour into a standardized measurement framework that enables systematic comparison across countries. Third, although search engine

analytics has been widely recognized as an alternative data source for forecasting economic activity, its application within Islamic economics has yet to produce a comprehensive indicator capable of measuring global halal market opportunities. Finally, the integration of machine learning techniques to identify heterogeneous patterns of halal market opportunities across countries remains largely unexplored in the existing halal industry literature.

These limitations indicate the absence of a multidimensional index capable of transforming digital search behaviour into a measurable representation of halal industry opportunities. Such an index is particularly important because digital search activity may reflect consumers' latent interests before they materialize into actual purchases, investment decisions, or market expansion. Therefore, incorporating search engine analytics into halal industry assessment may complement conventional indicators by providing a leading indicator rather than relying solely on lagging economic statistics.

To address this gap, this study proposes the Global Halal Industry Opportunity Index (GHIOI), a novel composite index developed from search engine analytics to assess the digital opportunity of the global halal industry. Unlike previous studies that primarily describe search trends, GHIOI integrates multiple dimensions of digital market behaviour, including search intensity, growth momentum, temporal stability, geographical diffusion, sectoral diversity, and projected future demand. Furthermore, this study employs machine learning techniques to classify countries according to their digital halal opportunity profiles, enabling a more comprehensive understanding of the heterogeneity of global halal markets.

Accordingly, this study addresses the following research questions: (1) How can search engine analytics be transformed into a multidimensional Global Halal Industry Opportunity Index (GHIOI)? (2) Which countries demonstrate the highest digital opportunities for halal industry development? (3) How can machine learning techniques classify countries based on their halal market opportunity profiles? and (4) To what extent can GHIOI function as a leading indicator for identifying emerging opportunities in the global halal industry?

This study aims to develop and validate the Global Halal Industry Opportunity Index (GHIOI) using search engine analytics and machine learning approaches. The study contributes to the literature in three significant ways. First, it introduces GHIOI as a novel measurement framework for assessing halal industry opportunities using digital behavioural data. Second, it extends the application of search engine analytics within Islamic economics by integrating machine learning techniques to reveal global patterns of halal market opportunities. Third, it provides policymakers, halal industry stakeholders, investors, and business practitioners with an evidence-based decision-support tool for identifying emerging halal markets and anticipating future industry developments before they are reflected in conventional economic indicators.

LITERATURE REVIEW

Global Halal Industry: Concepts and Recent Developments

The halal industry has transformed into a global economic ecosystem that extends beyond the provision of halal food to include pharmaceuticals, cosmetics, modest fashion, Muslim-friendly tourism, media, logistics, and Islamic financial services. This transformation has been driven by increasing consumer awareness of halal assurance, improvements in global halal supply chains, and the growing recognition of halal products as symbols of quality, safety, hygiene, and ethical production (DinarStandard, 2025). Consequently, the halal industry is no longer confined to Muslim-majority countries but has become an important component of international trade and sustainable economic.

The rapid expansion of the halal economy has attracted considerable attention from governments, multinational corporations, and international organizations. According to the *State of the Global Islamic Economy Report 2024/2025*, Muslim consumer expenditure across major halal sectors reached approximately US\$2.43 trillion in 2023 and is projected to increase to US\$3.36 trillion by 2028 (DinarStandard, 2025). The report also highlights significant growth in Islamic finance, halal pharmaceuticals, halal cosmetics, and Muslim-friendly tourism, demonstrating that the halal industry has become an increasingly diversified and globally integrated economic sector.

Despite its remarkable growth, assessing the development of the halal industry remains challenging. Existing measurements generally rely on conventional indicators such as export values, market size, investment flows, numbers of halal-certified products, or Islamic financial assets. While these indicators provide valuable information regarding market performance, they primarily reflect economic activities that have already occurred. Consequently, they function as lagging indicators and are less capable of identifying emerging market opportunities before actual economic transactions take place (Salaam Gateway, 2025). This limitation highlights the need for alternative indicators capable of capturing early signals of market demand and supporting proactive decision-making within the global halal industry.

Search Engine Analytics as Digital Market Intelligence

The new digitalization of consumer behaviour has fundamentally changed the process through which consumers seek information and make purchasing decisions. Before purchasing products or services, consumers increasingly rely on online search engines to compare alternatives, evaluate product quality, verify halal certification, and obtain information regarding brands or destinations (Putri & Sjabadhyni, 2025; Kim & Priluck, 2025). Consequently, search engine queries generate digital traces that reflect consumers' information-search behaviour and market interests in real time.

Recent advances in digital economics have encouraged researchers to utilize search engine analytics as an alternative source of market intelligence. Compared with traditional surveys, search engine data offer several advantages, including high-frequency observations, broad geographical coverage, lower collection costs, and the ability to capture spontaneous consumer interests without direct intervention (Nuti et al., 2014). These characteristics have made Google Trends one of the most widely used platforms for

monitoring public attention, forecasting economic activities, analysing tourism demand, and identifying changes in consumer behaviour.

Within business and marketing research, search engine analytics has been successfully applied to investigate product demand, investment behaviour, consumer sentiment, and digital consumption patterns. More recently, halal industry scholars have begun to adopt Google Trends to explore digital interest in halal cosmetics, halal beauty products, and other halal-related topics. These studies demonstrate that search engine analytics can reveal geographical variations in consumer demand, identify emerging markets, and provide valuable insights that are often unavailable through conventional economic datasets (Koswara & Herlina, 2025). From the perspective of Islamic economics, digital search behaviour represents more than simple online activity. It reflects consumers' initial intention to obtain information regarding halal products and services before engaging in actual purchasing decisions.

Machine Learning for Opportunity Assessment

The increasing availability of large-scale digital data has encouraged the adoption of machine learning techniques in economic and business research. Unlike conventional statistical methods that primarily focus on hypothesis testing, machine learning enables researchers to identify hidden structures, classify observations, and discover complex patterns within multidimensional datasets (Jordan & Mitchell, 2015).

Among various machine learning approaches, unsupervised learning techniques are particularly useful when labelled data are unavailable. Cluster analysis, especially the K-Means algorithm, has been widely employed to classify markets, consumers, and regions according to similar behavioural characteristics. By minimizing within-cluster variation while maximizing differences between clusters, K-Means facilitates the identification of homogeneous market segments that may require different strategic approaches (Shmueli et al., 2020).

In the context of the halal industry, machine learning provides opportunities to move beyond descriptive analysis by identifying countries with similar digital market characteristics. Rather than simply ranking countries based on search volume, clustering techniques can reveal groups of mature, emerging, and high-potential markets using multiple indicators simultaneously. Such classification provides richer strategic information for policymakers and business practitioners seeking to identify promising halal market opportunities.

Development of Composite Indices

Composite indices have become widely accepted instruments for measuring multidimensional phenomena that cannot be adequately represented by a single indicator. They integrate multiple variables into a unified measure, allowing researchers to compare entities, monitor development, and support evidence-based policy formulation (Greco et al., 2019).

The construction of a reliable composite index generally involves several methodological stages, including indicator selection, data normalization, weighting procedures, aggregation methods, and robustness evaluation. Each stage requires theoretical justification to ensure that the resulting index accurately represents the underlying construct and produces meaningful comparisons across observations (Greco et al., 2019).

Within Islamic economics, several composite indices have been developed to measure Islamic economic performance, financial inclusion, *maqasid al-sharia* achievement, and halal ecosystem development. However, these indices primarily rely on macroeconomic statistics, institutional indicators, or survey-based information. To date, limited attention has been given to integrating digital behavioural data into composite measurement frameworks. Consequently, the potential of search engine analytics for constructing a comprehensive indicator of halal industry opportunities remains largely unexplored.

Unlike existing composite indices in the Islamic economy, the proposed Global Halal Industry Opportunity Index (GHIOI) differs in several important aspects. First, most existing indices, such as the Global Islamic Economy Indicator, are constructed using macroeconomic variables, trade performance, halal certification, investment, and institutional indicators that are typically reported annually and therefore reflect realized market conditions (DinarStandard, 2025). In contrast, GHIOI is derived from high-frequency digital search behaviour captured through Google Trends, allowing it to identify changes in consumer attention before they are reflected in conventional economic statistics. Second, previous indices primarily assess the current competitiveness or performance of halal ecosystems. In contrast, GHIOI is designed to measure market opportunity by transforming digital demand signals into a multidimensional composite indicator. Third, GHIOI integrates search analytics with machine learning-based country classification, providing not only a country ranking but also a behavioural segmentation of global halal markets. Consequently, GHIOI complements rather than replaces existing halal economy indicators by offering a leading indicator for identifying emerging market opportunities.

The present study addresses this limitation by developing the Global Halal Industry Opportunity Index (GHIOI), which combines multiple dimensions of digital search behaviour into a unified measurement framework. By integrating search intensity, growth momentum, temporal stability, geographical diffusion, sectoral diversity, and projected demand, GHIOI is expected to provide a more dynamic representation of global halal market opportunities than conventional economic indicators alone.

Conceptual Foundation of the Global Halal Industry Opportunity Index (GHIOI)

Previous studies have established that search engine analytics can effectively capture public attention toward halal-related products and services. However, most existing studies remain descriptive and focus on individual sectors, such as halal cosmetics, halal tourism, or halal food. Moreover, digital search behaviour has rarely been transformed into a multidimensional measurement framework capable of comparing halal market opportunities across countries.

This study argues that digital search behaviour reflects consumers' latent market interest before it materializes into observable economic outcomes. Consequently, search engine data should not merely be interpreted as indicators of online popularity but as valuable signals of future market opportunities. Based on this perspective, the Global Halal Industry Opportunity Index (GHIOI) is conceptualized as a composite indicator that integrates multiple dimensions of digital search behaviour to assess the relative opportunity of halal industry development across countries.

The proposed framework assumes that countries demonstrating high search intensity, sustained growth momentum, stable search patterns, broad geographical diffusion, diverse sectoral interest, and positive future demand projections possess greater opportunities for halal industry expansion. Furthermore, machine learning techniques are employed to classify countries according to these multidimensional characteristics, thereby providing a more comprehensive understanding of global halal market heterogeneity.

Accordingly, GHIOI represents a methodological advancement in halal industry research by integrating digital behavioural data, composite index development, and machine learning into a unified analytical framework. This framework is expected to complement conventional halal industry indicators by providing a leading indicator capable of identifying emerging market opportunities before they are reflected in traditional economic statistics.

METHOD

This study employed a quantitative research design using search engine analytics to develop the Global Halal Industry Opportunity Index (GHIOI). The research relied on secondary data obtained from Google Trends, which provides normalized search interest data reflecting users' online information-search behavior over time. Google Trends has increasingly been recognized as a reliable source of digital trace data for economic and business research because it captures real-time public attention and consumer interests that may precede actual market behavior (Hair et al., 2022).

The data covered the period from 2019 to 2025 with weekly observations at the global level. To represent the major sectors of the halal economy, this study employed four Google Trends Topics: Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance. The use of Topics, rather than exact keywords, enabled multilingual searches and reduced linguistic bias across countries, thereby providing a more comprehensive representation of global search behavior.

Data collection was conducted using the Python programming language through the Pytrends library. The extracted data consisted of search interest over time, geographical distribution of search interest, and related topics. Following data collection, preprocessing procedures were undertaken, including data cleaning, alignment of time-series observations, treatment of missing values, and normalization to ensure comparability among indicators. According to Hair et al. (2022), data preparation is an essential stage in quantitative analysis because the quality of statistical results depends heavily on the quality and consistency of the underlying dataset.

The development of the Global Halal Industry Opportunity Index (GHIOI) followed the principles of composite indicator construction. Composite indicators combine multiple variables into a single measurement to represent multidimensional phenomena that cannot be adequately explained by a single variable (OECD & JRC, 2020). Accordingly, GHIOI was constructed using six dimensions: search intensity, growth momentum, temporal stability, geographical diffusion, sectoral diversity, and forecast demand. Each indicator was normalized using the Min–Max normalization technique to transform different measurement scales into comparable values ranging from 0 to 1 before aggregation into the final index score.

The Global Halal Industry Opportunity Index (GHIOI) was constructed by aggregating six normalized dimensions representing different aspects of digital halal market opportunities. Following the OECD and Joint Research Centre (2020) guidelines for composite indicator development, equal weighting was adopted to ensure a balanced contribution of each dimension. The GHIOI for a country i is calculated as follows:

$$GHIOI_i = \sum_{k=1}^6 w_k X_{ik}$$

$$\sum_{k=1}^6 w_k = 1$$

where w_k denotes the weight assigned to each dimension and X_{ik} represents the normalized score of dimensions k for country i . Since equal weighting was employed, each dimension received a weight of $1/6$. Accordingly, the GHIOI for country i is calculated as follows:

$$GHIOI_i = \frac{HF_i + HC_i + HT_i + IF_i}{4}$$

where:

- HF_i = Halal Food index
- HC_i = Halal Cosmetics index
- HT_i = Halal Tourism index
- IF_i = Islamic Finance index

To classify countries according to their digital halal market opportunities, this study employed the K-Means clustering algorithm, one of the most widely used unsupervised machine learning techniques for market segmentation and pattern recognition (James et al., 2021). The optimal number of clusters was determined using the Elbow Method and validated by the Silhouette Score. The resulting clusters were interpreted as representing countries with high, medium, and emerging halal industry opportunities.

Finally, descriptive statistical analysis and data visualization were performed to interpret the findings. Time-series analysis was used to identify search trends, while choropleth maps illustrated the geographical distribution of search interest across countries. Cluster visualization was subsequently employed to compare the characteristics of each country group. All data processing, visualization, index construction, and machine

learning analyses were conducted using Python, utilizing libraries including *Pytrends*, *Pandas*, *NumPy*, *Scikit-learn*, *Matplotlib*, and *Plotly*.

RESULT AND DISCUSSION

Global Trends of Digital Interest in the Halal Industry

To provide an overview of the evolution of digital interest in the halal industry, weekly Google Trends data were analysed for four representative sectors, namely Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance, covering the period from 2019 to 2025. Figure 1 presents the temporal patterns of global search interest across these sectors, allowing comparison of their relative search dynamics over time.

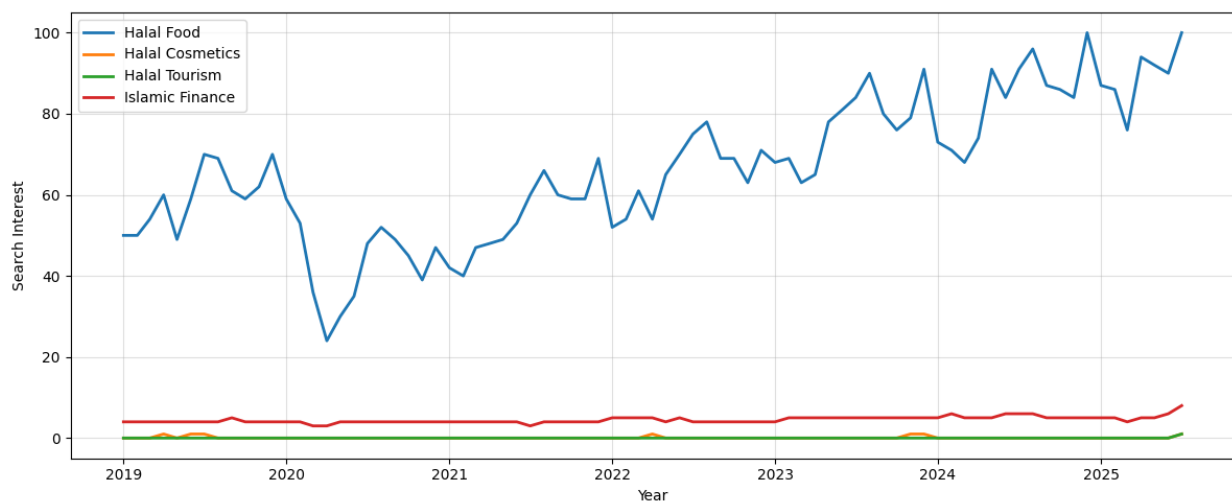


Figure 1
Global Google Search Trends of Halal Industry

Figure 1 illustrates the global search interest for four representative halal industry sectors, Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance, based on Google Trends data from 2019 to 2025. Overall, the results indicate that digital interest in the halal industry has generally increased during the observation period, although each sector exhibits distinct temporal patterns.

Among the four sectors, Halal Food consistently recorded the highest search interest throughout most of the study period. The search index fluctuated between approximately 20 and 80 during 2019–2025, showing a gradual upward trend despite several temporary declines. Compared with the other sectors, Halal Food demonstrated relatively stable public attention, suggesting that food remains the most established and widely recognized component of the global halal industry. This finding is consistent with the dominant role of the halal food sector in the global halal economy, where food accounts for the largest share of Muslim consumer expenditure (DinarStandard, 2025).

In contrast, Islamic Finance displayed moderate but steadily increasing search interest. Although its search volume remained substantially lower than Halal Food, the overall trajectory suggests growing global awareness of Islamic financial products and services. This pattern aligns with the continued expansion of Islamic financial assets and

increasing international adoption of Sharia-compliant financial instruments reported in recent global Islamic economy reports (DinarStandard, 2025).

Meanwhile, Halal Cosmetics and Halal Tourism exhibited relatively low and stable search interest for most of the observation period. Both sectors generally fluctuated within a narrow range, indicating more limited digital attention compared with Halal Food and Islamic Finance. Nevertheless, slight upward movements can be observed after 2022, reflecting the gradual diversification of consumer interest across halal lifestyle sectors.

A notable feature of Figure 1 is the sharp increase observed during the final weeks of 2025 across all four search topics. Search indices rapidly approached the maximum Google Trends value (100), particularly for Halal Tourism and Islamic Finance. Because Google Trends normalizes search intensity within the selected time window, these simultaneous spikes should be interpreted cautiously. They indicate an unusually high level of relative search activity during the final observation period rather than absolute increases in search volume. Additional investigation using related queries, news events, or rolling-window validation is therefore required before attributing these peaks to specific economic or social events.

Overall, the findings suggest that digital search behavior differs considerably across halal industry sectors. Halal Food consistently attracts the greatest public attention, whereas Islamic Finance demonstrates sustained long-term growth. Halal Cosmetics and Halal Tourism remain emerging sectors in terms of digital search interest, although both exhibit signs of gradual expansion. These results support the argument that search engine analytics provides valuable real-time insights into public interest and may serve as an alternative data source for monitoring the evolution of the global halal industry.

Spatial Distribution of Global Halal Search Interest

The geographical distribution of Google search interest reveals substantial variation in digital attention across countries and halal industry sectors (Table 1). Rather than being concentrated exclusively in Muslim-majority countries, search interest is distributed across regions with different demographic, economic, and institutional characteristics, suggesting that the halal industry has increasingly become a global economic phenomenon.

Table 1
Top 10 Countries by Google Search Interest across Major Halal Industry Sectors

No	Halal Food	Halal Cosmetics	Halal Tourism	Islamic Finance
1	Singapore	Brunei	Brunei	Maldives
2	Brunei	Mauritius	Maldives	Somalia
3	Malaysia	Malaysia	Malaysia	Brunei
4	United Kingdom	Singapore	Lebanon	Gambia
5	Canada	Pakistan	Réunion	United Arab
6	Australia	Montenegro	Indonesia	Pakistan
7	China	Sri Lanka	Singapore	Malaysia
8	Maldives	United Arab Emirates	United Arab Emirates	Bahrain
9	St. Helena	Bangladesh	Qatar	Djibouti
10	New Zealand	Qatar	Philippines	Ethiopia

Table 1 presents the top ten countries with the highest Google search interest across the four major halal industry sectors, namely Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance. The results indicate substantial variation in country rankings across sectors, suggesting that digital interest in the halal industry is multidimensional rather than uniformly distributed. While some countries consistently appear among the leading positions across several sectors, others demonstrate strong search interest only in specific halal industries.

For the Halal Food sector, Singapore recorded the highest search interest (Index = 100), followed by Brunei (25) and Malaysia (21). Other countries appearing among the top ten include the United Kingdom, Canada, Australia, China, Maldives, St. Helena, and New Zealand. The dominance of Singapore is noteworthy because, despite being a Muslim-minority country, it has developed into a regional halal trade and logistics hub supported by advanced digital infrastructure, international trade connectivity, and a highly diversified food industry. The presence of several Western countries among the leading search regions further indicates that halal food has evolved beyond a religious market into a broader consumer segment associated with food quality, safety, and ethical production.

A different geographical pattern emerges in the Halal Cosmetics sector. Brunei achieved the highest search interest (100), followed by Mauritius (58), Malaysia (53), and Singapore (37). Other countries, including Pakistan, Sri Lanka, the United Arab Emirates, Bangladesh, and Qatar, also demonstrated relatively strong digital attention. Compared with halal food, search interest in halal cosmetics appears to be more concentrated in countries with significant Muslim populations or expanding halal lifestyle markets. This finding suggests that halal cosmetics remain closely associated with Muslim consumer preferences, although growing international interest indicates increasing market diversification.

The Halal Tourism sector exhibits a more specialized geographical distribution. Brunei (100) and the Maldives (56) dominate global search interest, while Malaysia, Lebanon, Indonesia, Singapore, the United Arab Emirates, and Qatar record comparatively lower scores. These results are consistent with the positioning of these countries as established destinations for Muslim-friendly tourism. Nevertheless, the relatively modest search indices outside the leading countries imply that digital interest in halal tourism remains concentrated within a limited number of destinations, highlighting opportunities for destination marketing and tourism development in emerging halal tourism markets.

For Islamic Finance, the geographical pattern differs substantially from the other sectors. Maldives (100) and Somalia (95) recorded the highest search interest, followed by Brunei (87), Gambia (65), United Arab Emirates (56), Pakistan (39), Malaysia (38), Bahrain (36), Djibouti (31), and Ethiopia (20). The concentration of search interest in countries where Islamic financial systems are rapidly expanding suggests that demand for digital information is closely related to financial inclusion and the adoption of Sharia-compliant financial services. Unlike halal food, which attracts widespread global attention, Islamic finance appears to exhibit stronger regional concentration within Muslim-majority economies.

Overall, three important patterns emerge from the spatial analysis. First, Southeast Asian countries, particularly Brunei, Malaysia, Singapore, and the Maldives, consistently appear among the leading countries across multiple halal sectors, reinforcing their strategic role within the global halal ecosystem. Second, the geographical distribution differs considerably across sectors, indicating that consumer interest is heterogeneous rather than uniform throughout the halal industry. Third, the presence of non-Muslim-majority countries, such as Singapore, the United Kingdom, Canada, Australia, and New Zealand, demonstrates that digital demand for halal products and services increasingly extends beyond traditional Muslim markets. These findings support the argument that digital search behavior can reveal emerging halal market opportunities that may not yet be fully reflected in conventional economic indicators.

The observed spatial heterogeneity also provides an empirical foundation for the development of the Global Halal Industry Opportunity Index (GHIOI). Because countries exhibit distinct digital search profiles across halal sectors, integrating multiple search-based indicators into a composite index offers a more comprehensive approach to identifying global halal market opportunities than relying on a single search metric or conventional economic statistics.

Development of the Global Halal Industry Opportunity Index (GHIOI)

To evaluate digital opportunities within the global halal industry, this study constructed an initial Global Halal Industry Opportunity Index (GHIOI) by integrating search interest across four major halal sectors: Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance. The index was developed using the arithmetic mean of the four Google Trends search indices for each country, providing a composite measure of relative digital interest in the halal economy.

To provide a comprehensive assessment of digital market opportunities in the global halal industry, the Global Halal Industry Opportunity Index (GHIOI) was calculated by integrating search interest across the four major halal sectors: Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance. The resulting index enables cross-country comparison by summarizing multidimensional digital demand signals into a single composite score. Table 2 presents the ten countries with the highest GHIOI values, representing those with the strongest overall digital opportunity profiles within the global halal economy.

Table 2
Top 10 Countries by Global Halal Industry Opportunity Index (GHIOI)

Rank	Country	GHIOI
1	Brunei	78.00
2	Maldives	40.00
3	Singapore	38.00
4	Malaysia	32.25
5	Somalia	24.00
6	United Arab Emirates	22.50
7	Pakistan	20.25
8	Mauritius	18.25

9	Gambia	16.50
10	Bahrain	13.50

Table 2 presents the countries with the highest GHIOI scores. Among the 250 countries and territories included in the analysis, Brunei achieved the highest score (78.00), followed by Maldives (40.00), Singapore (38.00), and Malaysia (32.25). These countries consistently demonstrated relatively high search interest across multiple halal sectors, indicating a broad and diversified digital engagement with the halal economy.

Brunei's dominant position is particularly notable. The country ranked first in both Halal Cosmetics and Halal Tourism, while also recording very high search interest in Islamic Finance and Halal Food. This balanced performance across all sectors resulted in the highest composite score, suggesting that Brunei possesses a highly integrated digital halal ecosystem.

Maldives ranked second primarily because of exceptionally high search interest in Islamic Finance (100) and Halal Tourism (56). Although the country recorded relatively low search interest in Halal Food and Halal Cosmetics, the strong performance of these two sectors substantially increased its overall index value. Similarly, Singapore ranked third due to its outstanding performance in Halal Food (100), despite recording comparatively lower values in the remaining sectors. These findings indicate that countries may achieve relatively high opportunity scores through different sectoral strengths.

Malaysia occupies the fourth position with a GHIOI score of 32.25, reflecting moderate-to-high search interest across all four sectors consistently. Unlike Singapore and Maldives, whose scores are strongly influenced by one dominant sector, Malaysia demonstrates a more balanced digital profile. This suggests that diversified consumer interest across multiple halal industries contributes positively to overall market opportunity.

The remaining countries, including Somalia, the United Arab Emirates, Pakistan, Mauritius, Gambia, and Bahrain, exhibit moderate opportunity scores ranging from approximately 13 to 24. Their rankings are generally driven by strong performance in one or two sectors rather than consistently high search interest across the entire halal industry.

Descriptive statistics further reveal that digital halal search interest remains highly concentrated among a relatively small number of countries. As presented in Table 4, the average GHIOI score across all 250 countries is only 2.18, while the median score is 0.25. Moreover, the maximum value reaches 78.00, whereas the minimum value is 0, indicating substantial disparities in global digital engagement with halal-related topics. The large standard deviation (7.03) also confirms considerable heterogeneity among countries.

These findings imply that digital interest in the halal industry is not evenly distributed worldwide but concentrated in countries with stronger halal ecosystems or greater consumer awareness. Consequently, the GHIOI provides a useful preliminary indicator for identifying countries with relatively higher digital market opportunities before conducting further classification using machine learning techniques.

Country Classification Using Machine Learning

To further identify similarities in digital halal market characteristics, this study employed the K-Means clustering algorithm to classify countries based on their search behavior across four halal industry sectors and the composite GHIOI score. Unlike conventional ranking methods, clustering enables countries with similar digital profiles to be grouped together without relying on predefined categories, thereby providing a more nuanced understanding of global halal market opportunities.

To further explore the heterogeneity of digital halal market opportunities, countries were classified using the K-Means clustering algorithm based on their GHIOI dimensions and overall composite scores. Unlike simple ranking, clustering groups countries with similar digital search characteristics, allowing the identification of distinct opportunity profiles. Table 3 summarizes the characteristics of each cluster and their corresponding opportunity levels, providing a simplified interpretation of the segmentation results before discussing the cluster composition in greater detail.

Table 3
Characteristics of Country Clusters

Cluster	Characteristics	Opportunity Level
Cluster 1	High search interest across multiple halal sectors; diversified digital ecosystem	High Opportunity
Cluster 2	Moderate search interest concentrated in selected halal sectors	Emerging Opportunity
Cluster 3	Low search interest across most halal sectors	Developing Opportunity

Prior to clustering, all variables were normalized using the Min–Max normalization technique to eliminate differences in measurement scales. The optimal number of clusters was determined using the Elbow Method and subsequently validated using the Silhouette Coefficient. Based on these evaluation criteria, three clusters were selected as the optimal solution, representing countries with high, medium, and emerging halal industry opportunities (see Figure 2).

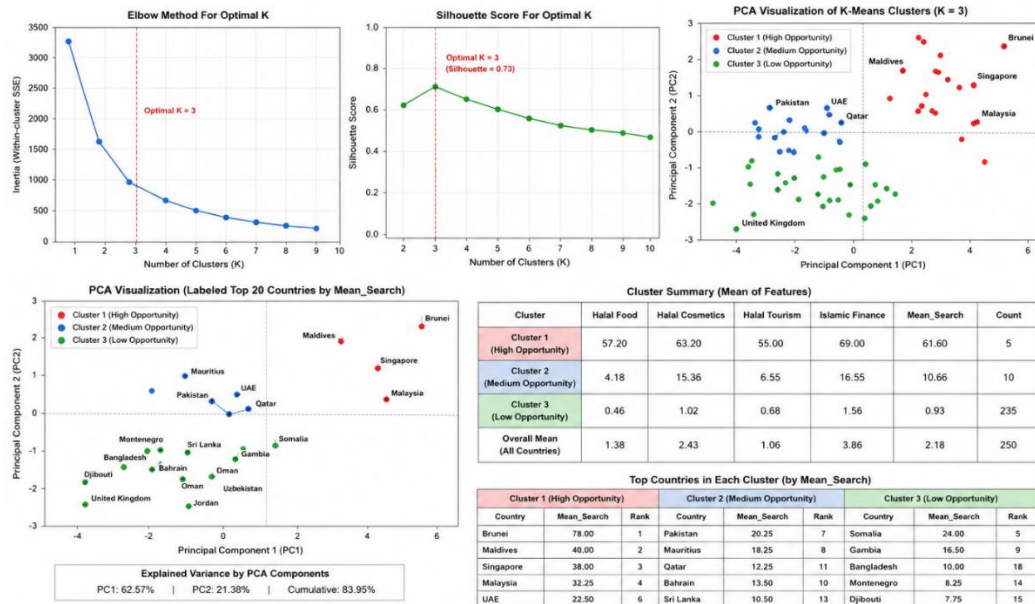


Figure 2
Country Classification Using K-Means Clustering
(Scatter plot atau PCA visualization K-Means.)

The clustering results as illustrated on figure 3, it reveals substantial heterogeneity among countries. Cluster 1 consists of countries exhibiting consistently high search interest across multiple halal sectors, including Brunei, Malaysia, Singapore, Maldives, and the United Arab Emirates. These countries represent mature digital halal ecosystems characterized by diversified consumer interest and relatively balanced search behavior.

Cluster 2 comprises countries with moderate search interest concentrated in one or two halal sectors. Examples include Pakistan, Bahrain, Qatar, Sri Lanka, and Mauritius. Although these countries demonstrate promising digital demand, their halal ecosystems appear less diversified than those in Cluster 1. Consequently, they may represent emerging halal markets with considerable growth potential.

The remaining countries belong to Cluster 3, which is characterized by relatively low search interest across most halal sectors. While these countries currently exhibit limited digital engagement with halal-related topics, they should not necessarily be interpreted as unattractive markets. Instead, the results indicate that halal industry awareness remains relatively limited or that consumer demand is still in the early stages of development.

The clustering analysis complements the GHIOI by moving beyond simple country rankings. Countries with similar GHIOI values may display different sectoral profiles, and clustering enables these differences to be identified more clearly. Therefore, the combination of a composite index and machine learning classification provides a more comprehensive framework for assessing global halal industry opportunities.

Overall, the findings demonstrate that digital halal markets are highly heterogeneous. While a relatively small group of countries has already established strong digital ecosystems across multiple halal sectors, many countries remain in transitional or emerging stages. These results provide valuable strategic insights for policymakers, investors, and halal industry stakeholders seeking to prioritize international market expansion.

Digital Search Behaviour as a Proxy for Halal Market Opportunity

The findings of this study suggest that digital search behaviour can serve as a meaningful proxy for identifying market opportunities within the global halal industry. Compared with conventional economic indicators, which are often released with considerable reporting delays, search engine analytics provide real-time behavioural signals that reflect consumers' information-seeking activities. Consequently, fluctuations in online search behaviour may function as leading indicators of emerging market demand rather than merely describing existing market conditions (Hölzl et al., 2025; Liu, 2024).

The empirical results demonstrate that countries with consistently high search interest across multiple halal sectors, including Brunei, Malaysia, Singapore, and the Maldives, obtained the highest GHIOI scores. This finding indicates that digital attention toward halal-related products and services is concentrated in a relatively small number of countries rather than being uniformly distributed worldwide. Such concentration reflects differences in consumer awareness, digital engagement, and the maturity of national halal ecosystems. Therefore, GHIOI should be interpreted as an indicator of relative digital market opportunity rather than a direct measure of market size or consumer expenditure.

These findings are consistent with the consumer information search theory, which explains that consumers actively seek information before making purchasing decisions, especially for products characterised by uncertainty and quality verification. Halal products belong to the category of credence goods, whose compliance with Islamic principles cannot be directly evaluated by consumers. Consequently, online search activity becomes an important stage in the purchasing process, as consumers seek information regarding halal certification, ingredients, and product credibility before making consumption decisions.

The present study also supports the growing literature on digital trace data, which argues that online behavioural data generated through search engines can complement conventional survey-based research. Unlike questionnaires that capture respondents' perceptions or intentions, Google Trends records actual information-seeking behaviour generated by millions of internet users in real time. Consequently, search engine analytics provide more dynamic and timely insights into changes in consumer attention and emerging market trends (Gummer & Oehrlein, 2025; Saputro, 2024).

An important contribution of this study is the development of the Global Halal Industry Opportunity Index (GHIOI), which integrates digital search interest across four strategic halal sectors into a single composite indicator. Previous studies have generally employed Google Trends to analyse individual sectors, forecast consumer demand, or explain specific economic phenomena. In contrast, the present research extends this approach by constructing a cross-country composite index that enables systematic comparisons of digital halal market opportunities among countries. This multidimensional framework captures broader patterns of digital engagement that cannot be identified through single-keyword analyses alone.

Furthermore, the integration of machine learning with search engine analytics enhances the analytical capability of the proposed framework. By applying K-Means clustering after constructing GHIOI, countries can be classified according to similarities in their digital halal market profiles rather than solely by their ranking scores. This

combination of composite index development and unsupervised machine learning provides a more comprehensive understanding of global halal market characteristics and offers practical guidance for policymakers, investors, exporters, and halal industry practitioners seeking priority markets for future expansion.

Nevertheless, several methodological limitations should be acknowledged. Google Trends reports relative search indices (0–100) rather than absolute search volumes. Accordingly, a country with an index value of 100 represents the highest relative search intensity within the selected dataset rather than the largest halal market globally. Moreover, search behaviour may be influenced by media coverage, temporary events, algorithmic changes, or seasonal factors that do not necessarily translate into sustained economic activity. Recent methodological studies therefore recommend careful validation and replication when Google Trends is used for scientific research (Hölzl et al., 2025; Liu, 2024).

Overall, the findings demonstrate that digital search behaviour constitutes a valuable source of market intelligence for the halal industry. Rather than replacing conventional economic statistics, GHIOI complements them by providing timely evidence of shifts in public attention and information demand. This approach contributes to the growing integration of digital analytics within Islamic economics research and offers a practical framework for identifying emerging halal market opportunities before they become fully reflected in traditional economic indicators.

CONCLUSION AND RECOMMENDATION

This study developed the Global Halal Industry Opportunity Index (GHIOI) using search engine analytics and machine learning to assess digital market opportunities across 250 countries and territories. By integrating Google Trends data from four major halal industry sectors—Halal Food, Halal Cosmetics, Halal Tourism, and Islamic Finance—the study demonstrates that digital search behaviour can provide valuable insights into the geographical distribution of public interest in the global halal economy. The findings reveal that digital attention is highly concentrated in a relatively small number of countries, with Brunei, Maldives, Singapore, and Malaysia consistently recording the highest GHIOI scores. These results indicate that digital engagement with halal-related topics varies substantially across countries, reflecting differences in consumer awareness, digital ecosystems, and sectoral development.

The study also contributes methodologically by proposing GHIOI as a composite indicator for evaluating halal market opportunities using digital trace data. Unlike previous studies that primarily focused on descriptive trend analysis or single-sector investigations, this research integrates search engine analytics with machine learning to classify countries according to their digital halal market characteristics. The clustering results demonstrate that countries exhibit heterogeneous opportunity profiles, suggesting that digital market intelligence can complement conventional economic indicators in identifying potential halal markets. Consequently, GHIOI offers an alternative analytical framework for governments, investors, exporters, certification bodies, and business practitioners seeking evidence-based strategies for international halal market development.

Despite these contributions, several limitations should be acknowledged. The analysis relies exclusively on Google Trends, whose indices represent relative rather than absolute search volumes and may be influenced by temporary events, media exposure, or algorithmic changes. Furthermore, the current GHIOI does not incorporate other indicators such as halal trade performance, certification statistics, investment flows, or e-commerce transactions. Future research is therefore encouraged to develop a multidimensional halal opportunity index by integrating search engine analytics with economic and institutional indicators, while also exploring more advanced machine learning and forecasting techniques. Such developments would strengthen the robustness of digital market intelligence and enhance its applicability for strategic decision-making in the rapidly evolving global halal industry.

REFERENCES

- Choi, H., & Varian, H. R. (2012). Predicting the Present with Google Trends. *Economic Record*, 88(S1), 2–9. <https://doi.org/10.1111/j.1475-4932.2012.00809.x>
- D'Amuri, F., & Marcucci, J. (2017). The Predictive Power of Google Searches in Forecasting Unemployment. *International Journal of Forecasting*, 33(4), 801–816. <https://doi.org/10.1016/j.ijforecast.2017.03.004>
- DinarStandard (2025) *State of the Global Islamic Economy 2025*. <https://www.dinarstandard.com/insights/sgier-2024-25>
- DinarStandard. (2025). *State of the Global Islamic Economy Report 2024/2025*. <https://www.dinarstandard.com/insights/sgier-2024-25>
- Greco, S., Ishizaka, A., Tasiou, M., & Torrisi, G. (2019). On the Methodological Framework of Composite Indices: A Review of the Issues of Weighting, Aggregation, and Robustness. *Social Indicators Research*, 141(1), 61–94. <https://doi.org/10.1007/s11205-017-1832-9>
- Gummer, T., & Oehrlein, A.-S. (2025). Using Google Trends data to study high-frequency search terms: Evidence for a reliability-frequency continuum. *Social Science Computer Review*. <https://doi.org/10.1177/08944393241279421>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2022). *Multivariate Data Analysis (9th ed.)*. Cengage Learning.
- Hözl, J., Keusch, F., & Sajons, C. (2025). The (mis)use of Google Trends data in the social sciences: A systematic review, critique, and recommendations. *Social Science Research*, 126, 103099. <https://doi.org/10.1016/j.ssresearch.2024.103099>
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning: With Applications in R (2nd ed.)*. Springer.
- Jordan, M. I., & Mitchell, T. M. (2015). Machine learning: Trends, perspectives, and prospects. *Science*, 349(6245), 255–260. <https://doi.org/10.1126/science.aaa8415>
- Jun, S.-P., Yoo, H. S., & Choi, S. (2018). Ten Years of Research Change Using Google Trends: From the Perspective of Big Data Utilizations and Applications. *Technological Forecasting and Social Change*, 130, 69–87. <https://doi.org/10.1016/j.techfore.2017.11.009>
- Kadir, R. D., Maski, G., Wahyudi, S. T., & Sumantri, V. D. S. (2025). Financial inclusion's impact on reducing poverty: A bibliometric mapping. *Multidisciplinary Reviews*, 9(3), 2026120. <https://doi.org/10.31893/multirev.2026120>
- Kim, S., & Priluck, R. (2025). Consumer Responses to Generative AI Chatbots Versus Search Engines for Product Evaluation. *Journal of Theoretical and Applied Electronic Commerce Research*, 20(2), 93. <https://doi.org/10.3390/jtaer20020093>

- Koswara, A., & Herlina, L. (2025). Global Trends in the Halal Beauty and Skincare Industry: A Search Engine-Based Market Analysis. *International Journal of Halal Industry*. <https://journal.uui.ac.id/IJHI/article/view/39574>
- Liu, K. (2024). The measurement errors of Google Trends data. *Discover Data*, 2, Article 7. <https://doi.org/10.1007/s44248-024-00013-3>
- Nuti, S. V., Wayda, B., Ranasinghe, I., Wang, S., Dreyer, R. P., Chen, S. I., & Murugiah, K. (2014). The Use of Google Trends in Health Care Research: A Systematic Review. *PLoS ONE*, 9(10), e109583. <https://doi.org/10.1371/journal.pone.0109583>
- OECD, & Joint Research Centre. (2020). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. OECD Publishing.
- Putera, P. B., & Rakhel, T. M. (2023). Halal research streams: A systematic and bibliometrics review. *Cogent Social Sciences*, 9(1). <https://doi.org/10.1080/23311886.2023.2225334>
- Putri, Y.C., & Sjabadhyni, B. (2025). The impact of halal certification and halal awareness on consumer intentions to purchase skincare products online. *Islamic perspective on Communication and Psychology*, 2(1), 1-15.
- Salaam Gateway. (2025). *State of the Global Islamic Economy Report 2024/2025*. <https://salaamgateway.com/reports/state-of-the-global-islamic-economy-sgie-202526-report>
- Saputro, N. (2024). Google Trends, bank popularity and depositors' fears in Indonesia. *Managerial Finance*, 50(6), 1089–1100. <https://doi.org/10.1108/MF-03-2023-0144>
- Shmueli, G., Bruce, P. C., Gedeck, P., & Patel, N. R. (2020). *Data Mining for Business Analytics*. John Wiley & Sons Inc