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Article

Sustainable Halal Value Chain performance for MSMEs: the roles of digital technology, R&D, financing, and regulation as antecedents

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Sustainable Halal Value Chain performance for MSMEs: the roles of digital technology, R&D, financing, and regulation as antecedents

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ABSTRACT

This article aims to provide a comprehensive and trustworthy HVC model for Micro, Small, and Medium-Sized Enterprises (MSMEs) by considering the role of digital technologies, legislation, finance, and research and development. To give a comprehensive understanding of the subject matter, we employed quantitative research methods. We used a sample based on the database of The Halal Product Assurance Organizing Body (BPJPH) to collect data from 278 respondents. Our respondents are located in thirteen different Indonesian cities who run MSMEs and from various backgrounds, such as practitioners, associations, legislators, academics, and other pertinent stakeholders. According to our findings, research and development have a negligible impact on halal chain performance, while halal value chain elements have a considerable impact. Previous HVC research has primarily been descriptive, characterizing situations or concepts or reviewing literature, with little empirical assessment of the relationship between significant halal value chain aspects and value chain performance. Our research contributes in filling this gap.

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1. Introduction

According to several studies (Azis et al., 2017; Harsanto et al., 2022; Ruchkina et al., 2017; Widiyanto & Harsanto, 2017), Micro, Small, and Medium-Sized Enterprises (MSMEs) are critical to a nation's economic growth and provide a sizable contribution to the national economy (Harsanto & Firmansyah, 2023). Since MSMEs make up 99% of all business entities, they are crucial to Indonesia's economic expansion. Furthermore, MSMEs employ 96.9% of all workers in the nation and provide 60.5% of the GDP to the nation (Fanaja et al., 2023). The MSME halal industry is one area that is anticipated to significantly contribute to Indonesia's economic recovery. The growth of the Halal Value Chain (HVC) decreased by merely −1.72% in 2020, which was greater than the −2.07% decline in the growth of the national economy (Harsanto, 2020b).

Digitalization has helped businesses everywhere (Harsanto & Firmansyah, 2023; Zhou et al., 2019). Many earlier research have shown the importance of technology adoption and capacities for MSMEs (Hansen & Bøgh, 2021; Räisänen & Tuovinen, 2020; Zhou et al., 2019). This fact is particularly urgent when it comes to raising performance and competitiveness. However, many MSMEs in Indonesia continue to face difficulties with digital technology. Only roughly 18% of MSMEs are able to sell their products on websites and social media, compared to 37% who are comfortable using computers and the internet and 36% who still rely on traditional marketing strategies (Fanaja et al., 2023).

Regarding the 2019–2024 Sharia Economic Masterplan, the Halal Value Chain (HVC)'s performance is heavily influenced by the use of digital technology, R&D, sharia finance capital structure, and laws (Pradana et al., 2024). The halal value chain ecosystem is a novel concept that the sharia economic system presents today. From the manufacturing to the distribution phases, a variety of industrial sectors

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make up this halal value chain, which creates an integrated network of sharia-compliant economic activities (Bakhri et al., 2022). These days, the halal industry is growing quickly and has the potential to become a major player on the world stage. Among the top four global suppliers of halal food are Saudi Arabia, Malaysia, the United Arab Emirates, and Indonesia (Pradana et al., 2024). In addition, the concept of halal also drives contemporary advancements in accordance with the demographic realities of Muslim communities globally, where it is projected that there will be 2.2 billion Muslims worldwide by 2030, accounting for 26.4% of the world's population (Grim & Karim, 2011). This accomplishment is largely due to MSMEs, which make up up to 99% of all business entities in Indonesia and are the country's economic engine (Lim et al., 2024).

As per the 2018–2019 Global Islamic Economy Report, Indonesia is among the top ten largest consumer countries in every subsector of the halal business. In terms of food expenditure, travel expenditure, garment expenditure, media expenditure, and pharmaceutical expenditure, the country leads the world. With this knowledge, it is clear that Indonesia has a greater chance than other countries to develop sharia banking and economy. This fact is vital when it comes to strengthening the halal industrial sector or the halal value chain ecosystem in order to advance the sharia economy (Belás et al., 2015). In this study, researchers employed a more thorough methodology that included four major variables that affect HVC performance in the two primary halal industries, namely food and fashion: digital technology, R&D, finance, and laws (Harsanto et al., 2022). Moreover, unlike previous research on HVC, the Indonesian Sharia Economic master plan for 2019–2024 lacks a clear structure for halal enterprises. The framework is divided into parts on technology, R&D, sharia finance, and regulatory compliance.

The four-part structure will be validated in the context of MSMEs by this study, especially in light of the pandemic. Therefore, the aim of this study is to create a sustainable HVC model for MSMEs by considering the significance of funding, regulations, research and development, and technology use. We believe that the connection between those variables—which is seldom ever observed in previous research—is the novelty this research offers. We started by formulating the research questions: Does the usage of digital technology influence the HVC performance? Does R&D influence the HVC performance? Does R&D have effect on technology use and how is the mediating effect of the latter on the HVC performance? Does capital structure influence the HVC performance? Does the regulation influence the HVC performance?

2. Literature review

2.1. Research on halal value chain

According to Salahuddin et al. (2021), most studies on consumers' acceptance of halal food have focused on how individuals' own standards, values, and beliefs influence their behavior. The term 'halal value chain' refers to an intricate network of connected businesses that work together to produce and deliver halal products to consumers. This chain goes through several stages, including farming, processing, packing, transportation, marketing, and retail (Rejeb et al., 2021). Strict adherence to Islamic regulations is necessary at every point of this value chain to preserve halal purity and win over clients (Rahman et al., 2020). To improve the halal value chain and foster a robust halal ecosystem, stakeholders including growers, processors, distributors, retailers, and government organizations must work together successfully (Mahbubi & Uchiyama, 2020). However, publications regarding the halal value chain are still limited (Dewi et al., 2022). Salahuddin et al. (2021), who examined the halal value chain in Malaysia's halal business, is one of the most prominent ones. Nevertheless, there is a lack of study linking the halal value chain to other variables in the halal business.

2.2. Technology use on halal value chain performance

Technology adoption may improve the halal value chain's authenticity, efficiency, and transparency in small and medium-sized businesses (SMEs). In particular, the application of blockchain technology offers SMEs a permanent record of halal transactions, allowing them to demonstrate their compliance with

halal regulations and win over customers (Kartawinata et al., 2023). Hendayani and Fernando (2023) claim that the performance of the halal supply chain and the competitiveness of businesses are both positively impacted by the incorporation of blockchain. Similarly, Masudin et al. (2021) demonstrated how logistics performance is significantly impacted by employees' readiness to use technology in the halal meat sector.

The significance of halal value chain performance for research and development lies in improving the halal supply chain's efficiency, transparency, and integrity (Harsanto et al., 2024). Prior studies have indicated that enhanced traceability, quality control, and adherence to halal requirements are crucial. Technology is essential to accomplishing these objectives because it makes data analytics, real-time monitoring, and blockchain-based solutions for safe and transparent transactions possible. In order to suit the various demands of halal customers around the globe and to ensure authenticity and avoid fraud, research and development activities should concentrate on utilizing these technologies. These studies highlight how technology may improve the Halal value chain's overall performance. Thus, we formulated hypothesis 1.

H1: The use of digital technology has a positive effect on halal value chain performance.

2.3. R&D and technology use on halal value chain performance

The advancement and use of cutting-edge digital solutions, including as blockchain, sensor technologies, and data analytics platforms, depend heavily on research and development (R&D) spending. With the use of these technologies, members of the halal ecosystem may ensure product authenticity, expedite logistics, promote transparency, and optimize production processes. As a result, this enhances the competitiveness and overall performance of the halal value chain. Azmi et al. (2018) found that business performance in Malaysia's halal food sector may be positively impacted by combining different elements connected to the halal food supply chain, including technological, organizational, and environmental characteristics. Similarly, Masudin et al. (2021) illustrated that the willingness to embrace technology in the halal meat retail and manufacturing sector can elevate halal logistics performance. These findings align with the growing emphasis on the role of Islamic economics and finance in advancing the halal value chain, as emphasized by Antonio et al. (2020). Therefore, Hypothesis 2 and 3 were proposed.

H2: R&D has a positive effect on halal value chain performance.

H3: R&D has a positive effect on technology use.

2.4. Capital structure on halal value chain performance

The performance of small and medium-sized businesses (SMEs) operating in the halal value chain can be improved by using Sharia-compliant financing structures (Kadir & Alaaraj, 2023). Sharia-based financial mechanisms, such as asset-based lending (mudharabah) and profit-sharing (musharakah), are in line with Islamic ideals and help SMEs gain more credibility and recognition among Muslim customers. The performance of the HVC is affected by Shariah capital structures in a complex and multidimensional way. While Bakhri et al. (2022) emphasizes the role of Islamic financial institutions in the halal business, particularly with regard to Maqashid Shariah, Laksono (2022) emphasizes the importance of Islamic stocks in strengthening the Halal value chain. The significance of halal value creation in logistics is further explored by Karia and Asaari (2016), who highlight the potential for innovation and competitive advantage. This topic was also expanded by highlighting the importance of Shariah insurance in bolstering the Halal value chain—particularly in maintaining the viability of Shariah-based enterprises (Dzukroni & Afandi, 2023). These findings imply that the performance of the Halal value chain may be greatly improved by an integrated and well-structured Shariah capital system. Thus, Hypothesis 4 was formulated.

H4: Capital Structure has a positive effect on halal value chain performance.

2.5. Regulation and technology use on halal value chain performance

The enforcement of regulations by institutions such as government agencies and halal certification organizations fosters consumer trust and provides a framework for adherence to Islamic values, which is crucial in enhancing the performance of the halal value chain. By improving supply chain integrity and transparency, digital technology—most especially blockchain—plays a critical mediating function (Hendayani & Fernando, 2023). Through the use of digital platforms to distribute regulatory information, expedite certification procedures, and provide real-time supply chain monitoring, this integration promotes effective compliance and transparency (Pradana et al., 2024). The competitiveness of the sector depends on the effectiveness of the Halal certification system, which has been identified as a crucial regulatory component (Noordin et al., 2014). Studies also demonstrate that business success is positively impacted by Halal food certification, with operational performance serving as a mediating factor in this connection (Ab Talib et al., 2017). Overall Halal supply chain performance is greatly enhanced by the use of Halal certification and labeling procedures (Zainuddin et al., 2019). These results essentially highlight the critical role that laws and digital technologies play in improving the accuracy and effectiveness of the Halal value chain. Thus, we formulated hypotheses 5, 6, 7, and 8.

H5: Regulations have a positive effect on halal value chain performance

H6: Regulations have a positive effect on technology use.

H7: R&D has a positive effect on halal value chain performance through the mediation of technology use.

H8: Regulations have a positive effect on halal value chain performance through the mediation of technology use.

Salahuddin et al. (2021) state that the term ‘Halal Value Chain’ (HVC) refers to the industry’s collective efforts from the point of halal manufacturing input to distribution, marketing, and finally halal consumption. It is crucial to take into account the inputs (raw materials) used in the creation of halal items as well as the processing technique. While waiting for Muslim consumers to approve of the final product, the packaging also conveys halalness and cleanliness (Subianto, 2019). Indonesia appears to be a nation that is very concerned about the halal value chain, based on certain articles that were included in reputable publications like Rusydiana et al. (2023) and Mahbubi (2023). Thus, as seen in Figure 1, we would like to add to the body of HVC literature by using this study paradigm as the foundation for our quantitative research.

3. Method, data, and analysis

Long-term competitive advantage can come from valuable assets and competencies (Kruesi & Bazelmans, 2023). Digital technology, R&D, sharia capital structure, and regulations are the resources and competencies that might be the major emphasis when it comes to the Halal Value Chain (HVC) performance of MSMEs. According to the stakeholder approach, businesses should take into account the interests of all parties involved, not just shareholders (Hoque et al., 2023). In the context of Halal Value Chain (HVC) performance of food & beverage MSMEs, the stakeholders involved include customers, suppliers,

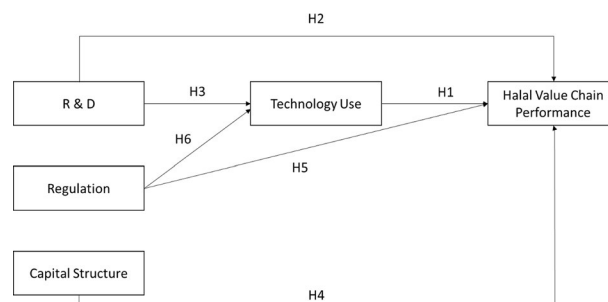


Figure 1. Research Model.

communities and regulators. Regulators are important stakeholders in the HVC industry because regulations can influence MSME business policies and strategies.

In order to examine quantitative data types, this study design uses quantitative techniques and the PLS-SEM methodology. Getting a thorough grasp of the phenomena under study was the goal. Convergent parallel design is the particular kind of mixed approach that is employed, in which the quantitative and qualitative stages are completed concurrently with the research process. Prior to being sent the questionnaires, participants attested to owning small or home businesses. Our sample consists only those responders who have such expertise with technology, have an R&D process, and have already obtained sharia finance. However, this study used selective sampling rather than random sampling as it lacked a sample frame of all Indonesian MSME owners with technical skills, R&D processes, and access to sharia funding.

With 278 respondents, data was gathered quantitatively from MSMEs in the small business sector in 13 Indonesian cities. Our first year data collection including these main cities: Greater Bandung, Jakarta, Yogyakarta, Surabaya, and Medan; The second year includes: Serang, Sukabumi, Makassar, and Balikpapan; The third year includes: Tasikmalaya, Semarang, Bali, and Lombok. The sampling frame used is from the Halal Product Guarantee Organizing Agency (BPJPH) with a stratified sampling data collection technique equipped with snowballing sampling. The respondents gave their informed consent in verbal and written statement before they participated in the study based on the ethical approval which was obtained from Universitas Padjadjaran Research Ethics Committee (Ref No: 1159/UN6.KEP/EC/2023). The ethical committee approved that the study was conducted in accordance with the Declaration of Helsinki (Ashcroft, 2008). Table 1 shows our respondents' profiles.

For analysis, we used PLS-SEM modeling techniques to analyze the data. PLS-SEM is useful for simultaneous equation analysis of several relationships in research models. Data analysis was done to confirm that the data were appropriate, to confirm the links between the constructs that were anticipated, and to evaluate how well the model predicted the exogenous components (Hair et al., 2017). This study used variance-based partial least squares with SmartPLS software because of this. This approach was also used since the data did not follow a normal distribution. Testing was done in two stages: model measurement analysis was done first to determine whether the data were appropriate, and model structure analysis was done next to determine the robustness of the model and the testing of suggested hypotheses (Suhartanto et al., 2022).

An analytical process with two steps (Hair et al., 2017). To examine the connections between the proposed variables, we first estimate a measurement model and subsequently a structural model. The Structural Equation Modeling (SEM) method with a Partial Least Square approach utilizing SmartPLS Software is used for data management in this study. Using the minimal R-squared technique, the

Table 1. Respondents' profiles.

Variables	Categories	Frequency	Percentage
Types of MSMEs	Food storage	67	41.6
	Snacks and beverages	94	58.4
	Food production	117	100.00
	Total	278	100.00
Sizes of MSMEs (based on annual revenues)	Ultra-micro	18	6.5
	Super-micro	3	1.1
	Micro-subsistent	257	92.4
	Total	278	100.00
Owner Ages	20–30 Years	31	11.1
	31–40 Years	68	24.4
	41–50 Years	121	43.6
	> 50 Years	58	20.9
	Total	278	100
Locations	Yogyakarta	21	7.5
	Jakarta	11	3.9
	West Java	162	58.2
	East Java	57	20.5
	North Sumatra	19	6.8
	Unanswered	8	3.1
	Total	278	100.00

Source. Author's own elaboration.

estimate was produced with a minimum sample size of 110, and the minimum R-squared achieved in this third trial was significantly lower than 0.1 (Kock & Hadaya, 2018).

3.1. Measurement

Research and development (five items), Islamic capital structure (three items), halal regulation (six items), technology utilization (fourteen items), and halal value chain performance (eight items) are the five components that are measured. Twenty questions make up the questionnaire, which was sent online to small business owners in 13 Indonesian cities. A five-point Likert scale, ranging from 1 (completely disagree) to 5 (absolutely agree), was used to rate each statement.

3.2. Convergent validity

The correlations were evaluated using a structural equation model in this work. Therefore, we ran a number of tests and collected data on factor loadings and convergent validity. How effectively an item represents the underlying construct is shown by factor loading. Generally, factor loading greater than 0.70 is advised, and lower value should be eliminated (Vinzi et al., 2010). However, our result did not show any values below threshold, thus we maintain all values. According to the results of the convergent validity test, including the loading factors of each indicator and AVE values for each study variable, are presented in Tables 2 and 3.

All indicators have loading factors larger than 0.7 and AVE values more than 0.5, as indicated by the processing findings displayed in Tables 2 and 3. This suggests that each indicator appropriately measures the corresponding hidden variable.

Table 2. Measurement model test results.

Variables	Items	Factor loadings	Verdict
R&D	RD1	0.820	Valid
	RD2	0.818	Valid
	RD3	0.853	Valid
	RD4	0.774	Valid
	RD5	0.866	Valid
Regulation	R1	0.876	Valid
	R2	0.875	Valid
	R3	0.891	Valid
	R4	0.873	Valid
	R5	0.834	Valid
	R6	0.694	Valid
Capital Structure	CS1	0.895	Valid
	CS2	0.760	Valid
	CS3	0.854	Valid
Technology Use	TU1	0.809	Valid
	TU2	0.831	Valid
	TU3	0.844	Valid
	TU4	0.853	Valid
	TU5	0.876	Valid
	TU6	0.862	Valid
	TU7	0.726	Valid
	TU8	0.856	Valid
	TU9	0.891	Valid
	TU10	0.830	Valid
	TU11	0.852	Valid
	TU12	0.866	Valid
	TU13	0.852	Valid
	TU14	0.844	Valid
Halal Value Chain Performance	HVC1	0.741	Valid
	HVC 2	0.824	Valid
	HVC 3	0.772	Valid
	HVC 4	0.756	Valid
	HVC5	0.646	Valid
	HVC6	0.759	Valid
	HVC7	0.744	Valid
	HVC8	0.840	Valid

Source. Author's own elaboration.

Table 3. Reliability.

Variables	AVE	Cronbach's alpha	Composite reliability
R&D	0.683	0.884	0.915
Regulation	0.711	0.917	0.936
Capital Structure	0.711	0.790	0.876
Technology Use	0.588	0.968	0.972
Halal Value Chain Performance	0.581	0.896	0.917

Source. Author's own elaboration.

Table 4. Fornell Larcker criterion.

	Halal value chain performance	Technology use	R&D	Regulation	Capital structure
Halal Value Chain Performance	0.762				
Technology Use	0.642	0.843			
R&D	0.544	0.782	0.827		
Regulation	0.625	0.687	0.688	0.843	
Capital Structure	0.482	0.442	0.557	0.535	0.838

Source. Author's own elaboration.

According to Hair et al. (2017), model fit has to be determined before moving on to structural model analysis (Fit Model). We carried out the computation by looking at the standard root-square residual (SRMR), which was suggested by Henseler et al. (2015). The SRMR value was calculated by the author to be 0.087%. If the SRMR value falls between 0.10 and 0.08, the model fit is considered adequate (Henseler et al., 2015; Hu & Bentler, 1999). A test of common method bias (CMB) was also carried out to ascertain whether there are any biased responses in the data set. Their findings revealed common factor loadings with a common variance level of 32%, but Podsakoff et al. (2003) state that a total variance for one component should not exceed 50% as the threshold number. Therefore, there are no CMB issues in the data set. Since greater than five suggests collinearity across conceptions, the VIF value must be less than five (Sarstedt et al., 2017).

Since no VIF value is more than five based on our VIF measurements, there is no multicollinearity problem. This fact is supported by the table below, which indicates that there is no significant relationship between the independent variables. Furthermore, we evaluated dependability, also known as internal consistency reliability, which quantifies the amount that the indicator variable increases in response to a rise in the concealed variable. Cronbach's Alpha (CA) and Composite Reliability (CR) are used in Table 3. Given that the values of their Composite Reliability (CR) and Cronbach's Alpha (CA) are greater than 0.70, it is evident that all latent variables are trustworthy. This demonstrates that each indicator, after an appropriate evaluation model has been chosen, measures each concept in the same way (Hair et al., 2017).

In PLS-SEM procedure, common method bias (CMB) is determined using an extensive collinearity evaluation methodology (Kock & Hadaya, 2018). The model's predictive power is demonstrated to be inadequate when there is a high degree of correlation between two or more independent variables or exogenous constructs (Sekaran & Bougie, 2019). The Variance Inflation Factor, or VIF, number is used to assess the CMB. For the model to be CMB-free, the VIF values must be below the 3.3 cutoff value (Hair et al., 2017; Kock & Hadaya, 2018). High VIFs may cause standardized estimates to be distorted and may complicate the identification of meaningful links. Our results show that the actual VIF values are between 1.305 and 1.480, indicating that there are no indications of CMB in the model.

3.3. Discriminant validity

According to Hair et al. (2021) the Fornell-Larcker criteria compares the greatest correlation value involving any other construct to the square root of the Average Variance Extracted (AVE) and the highest correlation value in any column or row. This strategy is based on the idea that latent variables ought to be better than other latent variables in explaining item variation. Table 4 shows that the AVE squared values exceed the correlation values for each individual construct after several indicators that did not match outer loading constraints were removed. When the correlation value between latent variables and the root value of the AVE (Fornell-Larcker Criterion) are same, a construct is considered legitimate. The

root value of AVE must be greater than the correlation of the latent variables. The discriminant validity is assessed using the Fornell Larcker. It contrasts the square root value of each construct's Average Variance Extracted (AVE) with the correlation between other constructs in the model (Henseler et al., 2015). If the AVE square root value for each construct is greater than the correlation value between that construct and other constructs in the model, the model is deemed to have outstanding discriminant validity. Thus, the research issue about the construct validity of the measurement model is addressed by the validation of the Fornell-Larcker criterion in the discriminant validity test (Table 4).

4. Result and discussion

According to Hair et al. (2017), model fit needs to be determined before moving on to structural model analysis (Fit Model). We carried out the computation by looking at the standard root-square residual (SRMR), which was suggested by Henseler et al. (2015). The SRMR value was calculated by the author to be 0.087%. If the SRMR value falls between 0.10 and 0.08, the model fit is considered adequate (Henseler et al., 2015).

4.1. Structural model analysis

Sekaran and Bougie (2019) define a structural model as one that connects endogenous variables with other endogenous factors or exogenous latent variables with endogenous latent variables. Based on the bootstrapping test, the full structural model yields the following results.

4.2. Discussion

Assessing the structural model comes next, after the assessment's finding of a decent measurement model (Hair et al., 2017). In a structural model, every hypothesis is linked to a causal relationship, and the hypothetical relationship of a structural model is often assessed using a route coefficient (Hair et al., 2021). The statistical significance of the coefficient is often determined by the *t*-value (Hair et al., 2017; Urbach & Ahlemann, 2010). *T*-value 1.65 (significance level = 10%), *t*-value 1.96 (significance level = 5%), and *t*-value 2.57 (significance level = 1%) are the key values that are often utilized in two-sided testing (Hair et al., 2017). If the hypothesis's *t* value—the link between the variables—was higher than the 1.96 cut-off value in this study, the hypothesis would be supported. In comparison, a hypothesis would be rejected if the hypothesis's *t* value (relationship between variables) was lower than the cut-off value of 1.96. For example, as presented in Figure 1 and Table 5, it can be observed that Technology Use → Halal Value Chain Performance obtained a significance level of $4.243 > 1.96$, the significance level is $0.000 < 0.05$, and the path coefficient value is a positive 0.441, which indicates the direction of the relationship between Technology Use and Halal Value Chain Performance is positive and significant. Therefore, the

Table 5. Path model analysis.

Hypotheses	Paths	Path coefficients	<i>T</i> -Values	<i>p</i> -Values	Verdict	Significance
H1	Technology Use → Halal Value Chain Performance	0.441	4.243	0.000	Accepted	Significant
H2	R&D → Halal Value Chain Performance	−0.109	1.049	0.295	Rejected	Not significant
H3	R&D → Technology Use	0.589	7.698	0.000	Accepted	Significant
H4	Capital Structure → Halal Value Chain Performance	0.190	2.682	0.008	Accepted	Significant
H5	Regulation → Halal Value Chain Performance	0.296	3.200	0.001	Accepted	Significant
H6	Regulation → Technology Use	0.282	4.000	0.000	Accepted	Significant

Source. Author's own elaboration.

hypothesis stating that Technology Use affects Halal Value Chain Performance is accepted. In other words, when digital technology is effectively utilized in activities such as farming, processing, packaging, logistics, marketing, and retail within the halal value chain, it can enhance the efficiency, transparency, and authenticity of the chain, leading to improved overall performance.

R&D→ Halal Value Chain Performance obtained t -value of $1.049 < 1.96$, the significance level of $0.295 > 0.05$ and path coefficients value is negative 0.109, which indicates the direction of the relationship between R&D to Halal Value Chain Performance is negative and not significant. The negative path coefficient suggests that as R&D increases, Halal Value Chain Performance tends to decrease, but since the relationship is not statistically significant, the study concludes that R&D does not significantly affect Halal Value Chain Performance. Therefore, the relationship is not accepted in this context. However, Zainuddin et al. (2019) found no significant impact of Halal traceability system on supply chain performance. Giyanti and Indriastiningsih (2019) also found no significant difference in profit margin before and after obtaining a Halal certificate, or between certified and non-certified SMEs. This study reveals that RnD expenditure has a positive yet insignificant effect on halal supply chain performance. One possible reason for this evidence is that RnD tends to be a long-term investment, rather than the short term. Thus, the true benefit may not be felt by the companies right after this investment is made. The companies may need to wait a bit longer to get the outcome of their RnD investment.

R&D→ Technology Use obtained a significant value of research that is t -value of $7.698 > 1.96$, the significance level of $0.000 < 0.05$ and path coefficients value is positive 0.589, which indicates the direction of the relationship between R&D to Technology Use is positive and significant. Therefore, it is acceptable that this study indicates that R&D influences technology use. Put another way, a focus on research and development tends to result in more people using technology. This is further supported by Barbieri et al. (2019), who show that technical potential and R&D productivity are positively correlated.

Capital Structure→ Halal Value Chain Performance obtained a significant value of research that is t -value of $2.682 > 1.96$, the significance level of $0.008 < 0.05$ and path coefficients value is positive 0.190, which indicates the direction of the relationship between Capital Structure to Halal Value Chain Performance is positive and significant. Therefore, it is acceptable that this study concludes that capital structure influences the performance of the halal value chain. Put differently, a focus on capital structure is generally associated with improved Halal Value Chain Performance. This is corroborated by Usmanova et al. (2022), who discover that supply chain orientation has a major effect on halal SMEs' performance. Ab Talib et al. (2017) provide a particular relationship between company success and halal food certification, indicating that the former can have a favorable impact on the latter's operational and financial performance.

Regulation→ Halal Value Chain Performance obtained a significant value of research that is t -value of $3.200 > 1.96$, the significance level of $0.001 < 0.05$ and path coefficients value is positive 0.296, which indicates the direction of the relationship between Regulation to Halal Value Chain Performance is positive and significant. It is acknowledged that this study indicates that regulation has an impact on the performance of the halal value chain. The study on the link between Regulation and Technology Use found that the t -value was $4.000 > 1.96$, the significance level was $0.000 < 0.05$, and the path coefficient value was positive 0.282. These results suggest that the relationship between Regulation and Technology Use is both significant and positive. This study concludes that regulation has an impact on the use of halal technology, which is acknowledged to be positive and significant.

In addition, the Table 6 shows the mediation effect of Technology Use, it shows the indirect influence of R&D→ Technology Use → Halal Value Chain Performance obtained the value of the significance level of $0.000 < 0.05$, and the value of path coefficients was positive at 0.259 which indicates R&D against Halal Value Chain Performance through Technology Use is positive and significant. Specifically, it suggests that as companies or entities invest more in R&D, it positively influences their use of technology, which, in turn, positively impacts the performance of the Halal value chain.

Regulation→Technology Use→Halal Value Chain Performance obtained the value of the significance level of $0.013 < 0.05$, and the value of path coefficients was positive at 0.124 which indicates Regulation against Halal Value Chain Performance through Technology Use is positive and significant. Specifically, it suggests that as regulation increases, there is a positive and significant effect on technology use, and in turn, technology use positively influences Halal value chain performance. Azmi et al. (2018) further

Table 6. Path model analysis (indirect effects).

Hypothesis	Paths	Path coefficient	<i>p</i> Values	Verdict	Significance
H7	R&D -> Technology Use -> Halal Value Chain Performance	0.259	0.000	accepted	Significant
H8	Regulation -> Technology Use -> Halal Value Chain Performance	0.124	0.013	accepted	Significant

Source. Author's own elaboration.

supports this, finding that the adoption of halal food supply chain factors, particularly in the technological context, significantly improves business performance. Noordin et al. (2014) emphasizes the role of regulatory bodies in ensuring the efficiency of the halal certification system, which can be enhanced through the strategic use of information systems.

5. Conclusion

The importance of digital technology, research and development (R&D), funding, and regulations as important antecedents has been highlighted by the study on the 'Sustainable Halal Value Chain Performance for MSMEs'. Digital technology integration has shown to be a driving force behind increased market reach and operational efficiency, allowing MSMEs to more closely connect with the demands of the halal market (Pradana et al., 2024). Through innovation and adaptation to shifting customer needs and regulatory norms, R&D initiatives have given these businesses even more capacity to innovate and promote sustainability throughout the value chain (Kartawinata et al., 2023). Furthermore, it has been determined that MSMEs' ability to obtain suitable funding is a critical factor, enabling them to make the investments and expand their businesses to satisfy the requirements of halal certification.

5.1. Theoretical implications

Our findings suggest that more regulation has a positive and significant influence on technology utilization, and that technology use has a beneficial impact on the Halal value chain's performance. Variables in the halal food supply chain, particularly when considering technology, significantly improve business success. Regulatory bodies can guarantee the efficacy of the halal certification system by strategically utilizing research and development (R&D) in information systems. Our study's findings might assist entrepreneurs in creating more sensible and effective strategic strategies for overseeing halal value chains and the components that support them. In terms of theoretical implications, our work adds to the body of knowledge on the halal value chain and its connections to capital structures, R&D, and regulation. As far as we are aware, no previous study has examined the relationship between those factors. The analysis in this publication might be beneficial to legislators, marketers, and scholars.

5.2. Practical implications

The research's conclusions can help policy makers and other stakeholders improve the performance of MSMEs that deal with halal value chain and logistics. Enhancing the efficiency of Indonesia's MSMEs offering halal food and drink will eventually raise the nation's profile among halal MSMEs worldwide. Regulatory frameworks offer crucial standards that protect the halal value chain's integrity, boosting consumer confidence and market competitiveness.

All things considered, the combined effect of these precursors forges a strong base for long-term expansion in the halal sector. For MSMEs to succeed in a global market that is becoming more regulated and competitive, it is not only advantageous but also essential to strategically incorporate these components. The halal value chain's sustainability and performance may be further improved by maximizing these variables in future research and policy development, which will eventually support the larger objectives of ethical business practices and economic development.

5.3. Limitation and suggestions for future research

We believe that this study's sample size is enough to meet our research questions. However, we also believe that regulators ought to be the subject of more research. It is also necessary to conduct research on different MSMEs. Indonesian government initiatives need the implementation of a strategy to establish a system of guaranteed halal products. It is advised to talk about a few major cities that are not on the Java and Sumatra islands. Finally, future research can also be conducted in a region with halal MSMEs, enabling us to compare our results with those of other countries.

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Authors' contributions

Budi Harsanto laid the fundamental body of the paper.
 Mahir Pradana compiled a research design and wrote the final paper.
 Egi Arvian Firmansyah wrote the previous theoretical background.
 Ardi Apriliadi conceptualized the instruments.
 Joval Ifghaniyafi Farras analyzed and interpreted the data.

Ethical approval

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the ethical approval was obtained from Universitas Padjadjaran Research Ethics Committee (Ref No: 1159/UN6.KEP/EC/2023).

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The datasets generated during and/or analysed during the current study are available from the corresponding author upon reasonable request.

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