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Assessing the Demand for Halal Storage: A Consumer Perspective from the Klang Valley

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ABSTRACT

The global Halal economy has grown rapidly, yet academic research on consumer demand for dedicated Halal storage services remains underdeveloped. Storage is a critical node where cross-contamination with non-Halal products can compromise supply chain integrity, but the consumer perspective on whether such services are valued and supported through purchase preferences, has rarely been examined. This study assesses Willingness to Pay (WTP) for dedicated Halal storage using the Theory of Planned Behaviour (TPB). A structured questionnaire was administered to 400 adult consumers residing in the Klang Valley (Kuala Lumpur and Selangor), Malaysia, recruited through dual-channel convenience sampling. Internal consistency, construct validity (KMO, Bartlett's, Exploratory Factor Analysis), descriptive distributions, non-parametric demographic comparisons, Pearson correlations and HC3-corrected multiple linear regression were used to evaluate the data. The TPB model demonstrated strong predictive power for WTP, with Attitude as the dominant predictor, Subjective Social Norms as a significant secondary predictor and Perceived Behavioural Control non-significant. Demographic post-hoc analyses revealed that Religion is the largest differentiator of WTP, with substantial non-zero WTP among non-Muslim respondents. The findings contribute to the Halal logistics literature by extending TPB to a backend, process-attribute service and offer practical guidance for Halal third-party logistics (3PL) providers, brand owners and certification bodies on consumer-pull strategies for dedicated Halal warehousing.

1. Introduction

The global Halal economy is estimated at USD 2.8 trillion annually and serves over 1.9 billion Muslim consumers worldwide (DinarStandard, 2022). Malaysia has positioned itself as a global Halal hub through the Department of Islamic Development (JAKIM), the MS1500 standard family and the Halal Industry

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Development Corporation. The bulk of regulatory and academic attention, however, has concentrated on production-stage compliance, slaughter, ingredient sourcing and product certification, while the post-production logistics nodes of storage and distribution have received considerably less scrutiny (Changalima, 2025; Handayani et al., 2022). Recent bibliometric reviews show that despite the rapid growth of Halal supply chain research, dedicated Halal warehousing remains thinly covered and operationally underdeveloped relative to product-level certification (Harsanto et al., 2024; Sarwar et al., 2021).

Storage is the node where cross-contamination, mixed handling and Halal-status compromise are most likely to occur, yet most warehousing in Malaysia continues to operate on a conventional (mixed-product) basis (Ali et al., 2021; Tan et al., 2020). Early conceptual work by Tieman et al. (2012) and Zailani et al. (2010) framed Halal integrity as a chain-wide property and more recent empirical and technological studies, including blockchain traceability frameworks for Halal logistics (Ali et al., 2021; Sunmola et al., 2025; Tan et al., 2020) and reviews of Industry 4.0 applications in Halal supply chains (Ellahi et al., 2025; Harsanto et al., 2024), have confirmed that storage integrity is technically achievable but economically dependent on whether the downstream market is prepared to support it.

This raises a conceptual question that has been underexplored in the literature: why would an ordinary consumer be willing to pay for a backend, infrastructure-level service such as Halal storage, given that the typical consumer does not directly contract with a warehouse operator? The present study takes the position that consumer Willingness to Pay (WTP) for Halal storage is best understood not as a direct payment to a warehouse provider but as a behavioural intention expressed through (i) preference for finished products that disclose Halal-segregated storage and (ii) acceptance of modest price premiums on such products. Consumers do not transact with storage providers directly, but the consumer signal is what creates a downstream market pull for third-party logistics (3PL) firms, brand owners and certification authorities to invest in Halal-dedicated infrastructure. This pull-side logic is well established in the broader literature on credence and process attributes, where consumer demand for invisible quality attributes (organic, fair-trade, geographic origin) has been shown to drive industry investment in upstream certification and supply chain redesign (Kovacs & Keresztes, 2022; Truong et al., 2022; Wu et al., 2021).

A research gap follows. To date, WTP research in the Halal domain has concentrated overwhelmingly on visible, product-level certification, the Halal logo on the finished product (Ahmed et al., 2019; Iranmanesh et al., 2020; Rezai et al., 2010). Evidence on consumer WTP for invisible, process-level attributes such as Halal storage is sparse. The closest precedent is Ngah et al. (2021), who applied TPB to consumer WTP for Halal transportation among Malaysian Muslim consumers and reported that all three TPB antecedents (attitude, subjective norms, perceived behavioural control) were significantly positive. Storage, however, is a more invisible node than transportation: a consumer can in principle observe a Halal-marked delivery truck but cannot observe how products were warehoused. Whether the consumer WTP pattern documented for transportation transfers to storage is therefore an open empirical question.

The present study addresses this gap and differs from Ngah et al. (2021) in three respects. First, the target service (storage) is a less visible node in the Halal supply chain than transportation, allowing a sharper test of the social-visibility thesis, the proposition that the normative pathway in TPB weakens when the behaviour cannot be observed by others (Bonne et al., 2007; Terry & Hogg, 1996). Second, this study includes non-Muslim respondents alongside Muslim respondents, enabling a cross-religious comparison rarely undertaken in the Halal WTP literature (Lim et al., 2022; Rezai et al., 2010). Third, the present study departs from the prevailing covariance-based analytic conventions in the Halal-TPB literature by combining heteroscedasticity-consistent (HC3) regression, non-parametric inference for demographic comparisons, effect-size reporting, and exploratory factor analysis for construct validity, providing a more conservative test of the TPB pathways.

The objectives of this study are therefore to (i) profile the consumer demographics of the Klang Valley market for Halal storage, (ii) examine whether demographic attributes differentiate WTP for Halal storage and (iii) test the three TPB hypotheses on the predictors of WTP. The contribution is empirical (first direct WTP modelling for Halal storage), theoretical (extending TPB from visible to invisible Halal supply chain

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services) and practical (offering JAKIM, 3PL providers and Halal-certified manufacturers a consumer-grounded basis for investment in dedicated Halal warehousing).

2. Literature Review

2.1 Halal Supply Chain and Storage Integrity

Halal refers to that which is permissible under Islamic law (Sharia). Traditional scholarship has equated Halal compliance with production-stage attributes, slaughter, ingredient sourcing, and processing, but the more recent supply chain literature has reframed Halal as a chain-wide integrity property (Changalima, 2025; Handayani et al., 2022; Tieman et al., 2012). Cross-contamination during storage and transportation has been documented as a significant and underappreciated source of Halal compromise; storage in particular is where products are most likely to come into contact with non-Halal goods through shared pallets, mixed cold-chain facilities and unsegregated dry storage (Ali et al., 2021; Rizki et al., 2023; Sarwar et al., 2021).

Malaysia's MS2400 family of standards (specifically MS2400-1:2019 on transportation, MS2400-2:2019 on warehousing and MS2400-3:2019 on retailing) sets technical criteria for Halal supply chain management. Despite this framework, a dedicated Halal warehousing infrastructure remains underdeveloped relative to the scale of the Malaysian Halal economy (Abd Rahman et al., 2023; Rizki et al., 2023). Emerging digital traceability technologies, blockchain, IoT-enabled warehouse management systems and AI-driven compliance monitoring have been proposed as enablers of Halal storage integrity (Ali et al., 2021; Harsanto et al., 2024; Sunmola et al., 2025; Tan et al., 2020), but technological feasibility does not guarantee commercial viability. The supply-side capacity to deliver dedicated Halal storage rests, in part, on whether consumer demand is sufficient to justify the higher unit cost of segregated facilities (Ellahi et al., 2025; Ngah et al., 2021).

2.2 Theory of Planned Behaviour and the Halal Supply Chain

The Theory of Planned Behaviour (TPB; Ajzen, 1991) posits that behavioural intention and, by extension, behaviour, is shaped by three antecedents: Attitude toward the behaviour (the individual's overall evaluation of performing the behaviour), Subjective Norms (perceived social pressure to perform or refrain from the behaviour) and Perceived Behavioural Control (the individual's perception of how easy or difficult performing the behaviour is, encompassing both internal capacity and external opportunity). Meta-analytic evidence across hundreds of behaviours supports TPB's explanatory power, with attitude typically the strongest antecedent of intention (Armitage & Conner, 2001).

TPB has been applied extensively to Halal consumer behaviour. Foundational studies showed that attitude, subjective norms, and perceived behavioural control are positively associated with Halal food purchase intention among Muslim consumers in Malaysia (Alam & Sayuti, 2011) and among Muslims and non-Muslims in non-Muslim-majority markets (Bonne et al., 2007). The framework has more recently been extended to Halal chocolate (Wan Nawang et al., 2023), Halal supplements (Tedjakusuma et al., 2023), Halal restaurant patronage (Halimi et al., 2022) and Halal logistics services (Ag Majid et al., 2021; Ngah et al., 2021). Across this body of work, attitude typically emerges as the strongest predictor, although the relative weight of subjective norms and perceived behavioural control varies with context, sample religiosity and the visibility of the behaviour (Iranmanesh et al., 2020; Mohd Yusof et al., 2025). The TPB framework therefore offers a well-validated structure for theorising consumer WTP for Halal services, while leaving open empirical questions about which antecedent dominates for any particular service.

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2.3 Willingness to Pay (WTP)

Willingness to Pay (WTP) is the maximum amount a consumer is willing to sacrifice in exchange for a good or service (Hanemann, 1991). Two distinctions are critical for the present study. First, WTP can be operationalised as a monetary valuation (the maximum price a consumer would pay) or as a behavioural intention (the disposition to support a service through preference and acceptance of price premiums). The behavioural-intention operationalisation is most appropriate in TPB-based research, where WTP is a proximal indicator of intended supportive behaviour rather than as a contingent valuation estimate (Ahmed et al., 2019; Ag Majid et al., 2021; Ngah et al., 2021). Second, WTP for visible product attributes, such as on-shelf Halal certification, differs theoretically from WTP for invisible process attributes such as warehousing. Drawing on the search–experience–credence typology (Darby & Karni, 1973; Nelson, 1970), visible product attributes can be inspected before purchase where invisible process attributes cannot, and consumers must rely on trusted intermediaries (certification bodies, brand reputation, third-party assurance) to verify them (Truong et al., 2022; Wu et al., 2021). Cross-domain meta-analytic evidence places the average WTP premium for sustainable food attributes, many of them credence in nature, at roughly 29.5% (Li & Kallas, 2021), suggesting that consumers do, on average, value process-level credence attributes when they trust the certification mechanism (Kovacs & Keresztes, 2022).

This study operationalises WTP for Halal storage as a behavioural intention to support dedicated Halal storage through (i) preference for finished products that disclose Halal-segregated storage and (ii) acceptance of modest price premiums on such products. WTP is not measured as direct payment to a warehouse operator (consumers do not contract with warehouse operators) and not as a contingent monetary valuation. The conceptualisation aligns with prior Halal-logistics WTP research that has likewise treated WTP as behavioural intention (Ag Majid et al., 2021; Ngah et al., 2021).

2.4 Attitude and Willingness to Pay

Attitude in TPB reflects an individual's positive or negative evaluation of performing a behaviour. In the Halal context, attitude toward Halal services is theorised as a function of Halal knowledge, religiosity and value alignment with Islamic teachings (Ahmad et al., 2015; Aziz & Chok, 2013). When a consumer evaluates Halal storage positively, perceiving it as important for Halal integrity and consistent with personal religious values, that positive evaluation is expected to translate into stronger intentions to support the service through purchase preference and price-premium acceptance.

Empirically, attitude has been the dominant TPB predictor across Halal consumer studies. Alam and Sayuti (2011) reported attitude as the strongest predictor of Halal food purchase intention in Malaysia. Bonne et al. (2007) found attitude to be the most consistent antecedent of Halal meat consumption among French Muslims. Ahmed et al. (2019) showed that attitude positively drove WTP for Halal-certified products in Pakistan. Ngah et al. (2021) confirmed the same pattern for Halal transportation WTP in Malaysia. The consistent dominance of attitude across visible (product) and process (transportation) Halal contexts grounds the expectation that attitude will also be the strongest antecedent of WTP for Halal storage.

H1: Attitude towards Halal storage has a significant positive effect on Willingness to Pay.

2.5 Subjective Social Norms and Willingness to Pay

Subjective Social Norms reflect the perceived expectations of significant others, family, friends, peers, and religious community regarding the focal behaviour. In the Islamic context, subjective norms take on a distinctive character through the concept of ummah, the collective religious community, which generates strong normative pressure around behaviours that signal religious commitment (Hassan & Hamdan, 2013). Where Halal-supportive behaviour is socially observable, individuals are theorised to align their choices with community expectations to maintain social identity and avoid disapproval (Bonne et al., 2007; Terry & Hogg, 1996).

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The empirical evidence on subjective norms in Halal consumer research is positive but more variable than for attitude. Alam and Sayuti (2011) reported a significant subjective-norms effect on Halal food purchase intention. Hassan and Hamdan (2013) emphasised the role of communal religious expectation in shaping Halal-supportive consumption. More recently, Mohd Yusof et al. (2025) reported subjective norms as the strongest predictor of general Halal product purchase intention among Malaysian consumers and Wan Nawang et al. (2023) reported the same dominance for Halal chocolate purchase. Ngah et al. (2021) confirmed a positive (though secondary to attitude) subjective-norms effect on WTP for Halal transportation. The breadth of this evidence supports the expectation that subjective norms will positively influence WTP for Halal storage, though the magnitude of the effect may be attenuated where the behaviour itself (consuming products that pass-through Halal-segregated storage) is not directly observable to others.

H2: Subjective Social Norms have a significant positive effect on Willingness to Pay.

2.6 Perceived Behavioural Control and Willingness to Pay

Perceived Behavioural Control (PBC) reflects the perceived ease or difficulty of performing the behaviour, integrating two analytically distinct dimensions: internal capacity (the resources, financial slack and ability to perform the behaviour) and external opportunity (the availability of the service in the marketplace) (Ajzen, 1991, 2002). For consumer WTP for a service that requires both financial capacity (paying a price premium) and market access (the availability of products that disclose Halal-segregated storage), both dimensions are relevant. In a developing-economy context such as Malaysia, financial constraints and uneven market accessibility of dedicated Halal-storage products may meaningfully shape PBC.

The empirical literature has reported PBC effects on Halal intention and WTP that are typically positive but often smaller and less consistent than attitude or subjective norms. Iranmanesh et al. (2020) reported a positive PBC effect on WTP for Halal-certified food. Alam and Sayuti (2011) similarly reported a significant positive PBC effect on Halal food purchase intention. Ngah et al. (2021) reported PBC as a positive antecedent of WTP for Halal transportation. However, PBC effects tend to weaken when the behaviour is high in social meaning but low in real-world resource demand, or when sample affluence is high enough that financial constraints lose discriminating power (Halimi et al., 2022; Wan Nawang et al., 2023). Given the conceptual relevance of PBC to a service that requires both financial slack and market access, the standard TPB hypothesis is retained for Halal storage.

H3: Perceived Behavioural Control has a significant positive effect on Willingness to Pay.

3. Methods

3.1 Research Design

The study adopts a quantitative, cross-sectional, deductive design. The deductive approach derives hypotheses from TPB and empirically tests its applicability to Halal storage WTP; the cross-sectional design captures consumer perceptions at a single point in time and is appropriate for testing antecedent–outcome relationships in a TPB framework, though it does not permit causal inference.

3.2 Population and Sampling

The target population comprises adult consumers (aged 18 and above) residing in the Klang Valley, encompassing Kuala Lumpur and Selangor (population > 7.5 million; Department of Statistics Malaysia, 2020). The Klang Valley is Malaysia's principal urban and economic agglomeration and contains the bulk of national consumer purchasing power, making it an appropriate context for assessing emergent demand for Halal storage services. A sample size of 400 was set, which exceeds conventional guidelines for

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multivariate analysis (Hair et al., 2019) and is consistent with comparable Halal-consumer studies (Alam & Sayuti, 2011; Ngah et al., 2021).

Convenience sampling was employed for two pragmatic reasons. First, no comprehensive sampling frame for "Klang Valley consumers of Halal products" exists, making probability sampling infeasible in practice. Second, convenience sampling is the standard approach in Malaysian Halal consumer research, including in widely cited studies on Halal food purchasing (Alam & Sayuti, 2011), non-Muslim awareness of Halal principles (Rezai et al., 2010) and Halal transportation WTP (Ngah et al., 2021). The limitations of convenience sampling are acknowledged. Data were collected through a dual-channel approach combining online distribution (social media and questionnaire link) and on-site distribution at high-footfall retail and community sites. The dual-channel approach was adopted to broaden reach across demographic strata and to mitigate the under-coverage characteristic of single-channel surveys (Dillman et al., 2014).

3.3 Instrument

A structured, self-administered questionnaire collected demographic data (Section A: gender, age, education, occupation, religion, monthly income) and TPB and WTP measurement items (Section B) on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Three items each measured Attitude (ATT), Subjective Social Norms (SN) and Perceived Behavioural Control (PBC); five items measured Willingness to Pay (WTP). Items were adapted from established instruments: Attitude items from Alam and Sayuti (2011), and Bonne et al. (2007); Subjective Social Norms items from Ngah et al. (2021) and Alam and Sayuti (2011); Perceived Behavioural Control items from Ajzen (1991, 2002) and Ngah et al. (2021); and Willingness to Pay items from Ahmed et al. (2019), Ag Majid et al. (2021) and Ngah et al. (2021). The complete instrument is provided in Appendix A.

In line with prior TPB research on Halal logistics, WTP is operationalised as a behavioural intention to support dedicated Halal storage through (i) preference for finished products that disclose Halal-segregated storage and (ii) acceptance of modest price premiums on such products. WTP is not measured as direct payment to a warehouse operator and not as a contingent monetary valuation; the magnitude of price premium consumers would pay is therefore beyond the scope of the present design and is suggested for future research using discrete-choice or auction methods.

Internal consistency was assessed via Cronbach's α prior to composite scoring. All constructs exceeded the α ⩾.70 threshold recommended for confirmatory research (Hair et al., 2019): Attitude α = .95 (excellent), Subjective Social Norms α = .82 (good), Perceived Behavioural Control α = .84 (good) and Willingness to Pay α = .86 (good). Corrected item-total correlations were all above.65, indicating strong item-construct alignment (see Table 1).

Table 1. Internal consistency reliability for TPB and WTP constructs (N = 400)

Construct	No. Of items	Cronbach's α	Item-total r (range)	Interpretation
ATT	3	.95	.88–.90	Excellent
SN	3	.82	.65–.71	Good
PBC	3	.84	.70–.71	Good
WTP	5	.86	.65–.72	Good

**Note. α ≥.70 acceptable, ≥.80 good, ≥.90 excellent (Hair et al., 2019).

3.4 Construct Validity

To assess construct validity, an Exploratory Factor Analysis (EFA) was conducted on the 14 items using Principal Axis Factoring with Promax rotation. The Kaiser-Meyer-Olkin measure of sampling adequacy was excellent at.964 (item-level KMO ⩾.93 for all items) and Bartlett's test of sphericity was significant (χ^2 = 4, 433.37, df = 91, p < .001), confirming the data were appropriate for factor analysis (Field, 2018; Hair et al., 2019). A four-factor solution was retained on theoretical grounds consistent with the four TPB-WTP latent constructs; the four factors jointly accounted for 68.16% of the total variance, exceeding the 60% benchmark for social-science research (Hair et al., 2019).

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Primary factor loadings were ⩾.50 for all of the items on their hypothesized factor (.55-.93), with Average Variance Extracted (AVE) exceeded the.50 threshold for all constructs (ATT = .54, SN = .57, PBC = .75, WTP = .59) and Composite Reliability exceeded the.70 threshold (ATT = .78, SN = .80, PBC = .90, WTP = .87) (Fornell & Larcker, 1981).

3.5 Data Analysis Techniques

Composite mean scores were computed for each construct. Distributional properties were assessed using the Shapiro-Wilk test, which was selected for its statistical power at sample sizes between 50 and 2, 000 (Razali & Wah, 2011). Given the non-normal distributions characteristic of TPB-WTP data with ceiling effects, non-parametric tests with effect sizes were used for demographic comparisons of WTP: Mann-Whitney U for two-group comparisons and Kruskal-Wallis H for k-group comparisons, with rank-biserial r and epsilon-squared (ε^2) reported as effect-size indices (Fritz et al., 2012; Tomczak & Tomczak, 2014).

For the multivariate analysis of TPB construct relationships with WTP, Pearson product-moment correlation was used as the primary bivariate measure, treating multi-item Likert composite scores as interval-level data, consistent with standard practice in TPB-based research (Field, 2018; Hair et al., 2019). Spearman's ρ was computed as a robustness check and yielded substantively consistent inferential conclusions, with directionally identical and statistically significant relationships at $p < .001$ across all construct pairs.

Multiple Linear Regression was used to evaluate the joint predictive contribution of Attitude, Subjective Social Norms, and Perceived Behavioural Control on Willingness to Pay. Three sets of diagnostics were applied. First, residual normality was assessed using the Shapiro-Wilk test on standardised residuals. Second, homoscedasticity was assessed using the Breusch-Pagan test, with HC3 heteroscedasticity-consistent standard errors (Hayes & Cai, 2007) applied as a robustness check to mitigate any standard-error bias under heteroscedasticity. Third, multicollinearity was assessed using Variance Inflation Factors with the conventional VIF < 5 threshold (O'Brien, 2007). The hypothesised TPB regression model intentionally excludes demographic control variables because the hypotheses concern TPB constructs only; demographic effects on WTP are examined separately in the post-hoc analysis. A supplementary regression including Religion as a categorical covariate was estimated as a robustness check and confirmed the stability of the TPB findings.

4. Findings

4.1 Demographic Profile

Table 2 summarises the demographic distribution of the 400 respondents. The sample was 60.2% female (n = 241) and 39.8% male (n = 159), predominantly aged 23–40 (70.5%) and 71.7% held a university degree or higher. Private sector employees were the largest occupational group (43.2%), followed by unemployed (19.8%), government (16.2%), students (15.5%), and self-employed (5.2%). The religious composition was 79.5% Islam, 9.8% Christian, 6.0% Buddhist, 2.0% Hindu, and 2.8% Others. The income distribution was 20.8% earning less than RM 1, 800/month, 23.2% RM 1, 801–RM 3, 000, 40.0% RM 3, 001–RM 4, 500 and 16.0% above RM 4, 500.

Table 2. Demographic profile of respondents (N = 400)

Demographic variable	Category	Frequency (n)	Percentage (%)
Gender	Male	159	39.8
	Female	241	60.2
Age	18–22 years	60	15.0
	23–30 years	178	44.5
	31–40 years	104	26.0
	41–50 years	34	8.5

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	> 50 years	24	6.0
Education	SPM	44	11.0
	Diploma	93	23.2
	Degree	192	48.0
	Master	62	15.5
	PhD	9	2.2
Occupation	Government	65	16.2
	Private Sector	173	43.2
	Student	62	15.5
	Unemployed	79	19.8
	Self-Employed	21	5.2
Religion	Islam	318	79.5
	Christian	39	9.8
	Buddhist	24	6.0
	Hindu	8	2.0
	Others	11	2.8
Income (Monthly)	< RM 1, 800	83	20.8
	RM 1, 801–RM 3, 000	93	23.2
	RM 3, 001–RM 4, 500	160	40.0
	> RM 4, 500	64	16.0

4.2 Descriptive Statistics and Normality

Composite means showed a generally favourable orientation across constructs (Table 3). Attitude was the highest (M = 4.557, SD = 0.971), followed by Willingness to Pay (M = 4.424, SD = 0.632) and Subjective Social Norms (M = 4.308, SD = 0.789); Perceived Behavioural Control was lower (M = 3.947, SD = 0.832). All Shapiro-Wilk statistics were significant at $p < .001$, indicating departure from normality. Composite scores exhibited negative skew and positive kurtosis for Attitude, Subjective Social Norms and Willingness to Pay, indicating ceiling-effect-like accumulation at the upper end of the scale.

Table 3. Descriptive statistics and Shapiro-Wilk normality test results (N = 400).

Construct	M	SD	Min	Max	Skewness	Kurtosis	W	P
ATT	4.557	0.971	1.00	5.00	−2.315	3.947	.511	< .001
SN	4.308	0.789	1.67	5.00	−1.771	2.386	.745	< .001
PBC	3.947	0.832	2.00	5.00	−0.780	−0.213	.908	< .001
WTP	4.424	0.632	1.80	5.00	−2.104	4.152	.725	< .001

4.3 Correlation Analysis

Pearson product-moment correlations among the four composite constructs were all significant at $p < .001$ (Table 4). Willingness to Pay was most strongly associated with Attitude (r = .888), followed by Subjective Social Norms (r = .805) and Perceived Behavioural Control (r = .616). The bivariate association between Attitude and Subjective Social Norms was also high (r = .874). Therefore, discriminant validity is not an issue with the dataset.

Table 4. Pearson product-moment correlation matrix (N = 400)

Construct	1. ATT	2. SN	3. PBC	4. WTP
1. ATT	,			
2. SN	.874***	,		
3. PBC	.663***	.632***	,	
4. WTP	.888***	.805***	.616***	,
M	*4.557*	*4.308*	*3.947*	*4.424*
SD	*0.971*	*0.789*	*0.832*	*0.632*

4.4 Multiple Linear Regression

The Multiple Linear Regression model was significant, $F(3, 396) = 504.04$, $p < .001$ and explained 79.3% of the variance in Willingness to Pay ($R^2 = .793$; Adjusted $R^2 = .791$). Diagnostics: standardised residuals departed from normality (Shapiro-Wilk W = .978, $p < .001$) and the Breusch-Pagan test indicated

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heteroscedasticity (LM = 38.52, p < .001), motivating the use of HC3-corrected standard errors as a robustness check (Hayes & Cai, 2007); HC3 standard errors yielded identical conclusions to OLS for all three predictors. Variance Inflation Factors were 4.64 for Attitude and 4.32 for Subjective Social Norms, below the conventional threshold of 5 (O'Brien, 2007) but in the upper range, indicating a notable shared variance and 1.82 for Perceived Behavioural Control.

Attitude was the dominant predictor (β = .761, t = 15.44, p < .001), supporting H1. Subjective Social Norms was a significant secondary predictor (β = .116, t = 2.43, p = .016), supporting H2. Perceived Behavioural Control was not significant (β = .039, t = 1.25, p = .213); H3 was not supported (Table 5).

A supplementary regression incorporating Religion as a categorical covariate (Islam as reference) was estimated as a robustness check responding to the role of religion in the Halal context. Adding the religion dummies marginally increased model fit (R^2 = .801), with Attitude (β = .710, p < .001) and Subjective Social Norms (β = .110, p = .020) remaining significant, while Perceived Behavioural Control remaining non-significant (β = .020, p = .566). The TPB findings are therefore robust to control for religion.

Table 5. Multiple linear regression: predictors of Willingness to Pay (N = 400).

Predictor	**β**	**SE**	T	P	**VIF**
(Constant)	,	0.084	19.59	< .001	,
ATT	.761	0.032	15.44	< .001	4.64
SN	.116	0.038	2.43	.016	4.32
PBC	.039	0.024	1.25	.213	1.82

4.5 Post-Hoc Analysis: Demographic Differences in Willingness to Pay

Although demographic differences were not hypothesised within the TPB framework, exploring them as a post-hoc analysis serves two purposes. First, it addresses the descriptive research objective of profiling consumer demographics and identifying demographic differentiators of Halal-storage WTP. Second, it provides market-segmentation insight for 3PL providers, brand owners and JAKIM by identifying which consumer segments are most receptive to dedicated Halal storage. The analysis is exploratory and not confirmatory. Therefore, the demographic findings should not be over-interpreted as causal tests.

Table 6 reports the non-parametric group comparisons with effect-size statistics. Gender produced no significant difference in WTP (U = 18, 993.00, p = .881, r = .009, negligible). Age was a significant differentiator, H(4) = 18.547, p = .001, ε^2 = .037 (small), with median WTP rising across age bands and peaking among the 50+ group (Mdn = 4.80). Education was significant, H(4) = 13.687, p = .008, ε^2 = .025 (small). Occupation was significant, H(4) = 12.385, p = .015, ε^2 = .021 (small). Income produced a significant effect, H(3) = 23.158, p < .001, ε^2 = .051 (small-to-medium), with the lowest income band (< RM 1, 800) reporting the lowest median WTP (Mdn = 4.40).

The most pronounced effect was for Religion, H(4) = 125.189, p < .001, ε^2 = .307 (large). Muslim respondents recorded the highest median WTP (Mdn = 4.60), followed by Others (Mdn = 4.60), Christian (Mdn = 4.20), Buddhist (Mdn = 3.00) and Hindu (Mdn = 2.70).

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Table 6. Non-parametric tests of demographic differences in Willingness to Pay with effect sizes.

Variable	Group	N	Mdn	Test statistic	P	Effect size	Interpret.
Gender (MW-U)	Male	159	4.60	U = 18, 993.00	.881	R = .009	Negligible
	Female	241	4.60				
Age (K-W)	18–22 yrs	60	4.40	H(4) = 18.547	.001**	ε^2 = .037	Small
	23–30 yrs	178	4.60				
	31–40 yrs	104	4.60				
	41–50 yrs	34	4.60				
	> 50 yrs	24	4.80				
Education (K-W)	SPM	44	4.40	H(4) = 13.687	.008**	ε^2 = .025	Small
	Diploma	93	4.60				
	Degree	192	4.60				
	Master	62	4.60				
	PhD	9	4.60				
Occupation (K-W)	Government	65	4.60	H(4) = 12.385	.015*	ε^2 = .021	Small
	Private Sector	173	4.60				
	Student	62	4.60				
	Unemployed	79	4.60				
	Self-Employed	21	4.40				
Religion (K-W)	Islam	318	4.60	H(4) = 125.189	< .001***	ε^2 = .307	Large
	Christian	39	4.20				
	Buddhist	24	3.00				
	Hindu	8	2.70				
	Others	11	4.60				
Income (K-W)	< RM 1, 800	83	4.40	H(3) = 23.158	< .001***	ε^2 = .051	Small-med
	RM 1, 801–3, 000	93	4.60				
	RM 3, 001–4, 500	160	4.60				
	> RM 4, 500	64	4.60				

Note. MW-U = Mann-Whitney U; K-W = Kruskal-Wallis H. R = rank-biserial [< .1 negligible, .1–.3 small, .3–.5 medium, > .5 large]; ε^2 = epsilon-squared [< .01 negligible, .01–.06 small, .06–.14 medium, > .14 large] (Fritz et al., 2012; Tomczak & Tomczak, 2014). * p < .05; ** p < .01; *** p < .001.

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5. Discussion

5.1 Discussion of Results

The regression results show that Attitude dominates the prediction of consumer Willingness to Pay for Halal storage, that Subjective Social Norms make a smaller but significant additional contribution, and that Perceived Behavioural Control does not contribute beyond the other two TPB antecedents. The pattern is broadly consistent with the dominant Attitude finding in the Halal-TPB literature (Alam & Sayuti, 2011; Ahmed et al., 2019; Bonne et al., 2007; Ngah et al., 2021) and with meta-analytic evidence that Attitude is typically the strongest TPB antecedent of intention (Armitage & Conner, 2001).

The very high explanatory power of the model, approximately four-fifths of the variance in WTP, exceeds the 40% to 60% typically reported in TPB research and therefore merits cautious interpretation. Three factors may plausibly contribute to this finding. First, the sample is demographically homogeneous, involving urban, educated, predominantly Muslim consumers from Klang Valley, for whom Halal-supportive attitudes and intentions are tightly aligned. Second, the design is a single source, with Attitude and WTP measured on the same instrument, from the same respondents, at the same time. Additionally, Harman's single-factor test indicates the presence of non-trivial shared method variance. Third, the WTP measure shows ceiling-effect-like clustering at the upper end of the scale, which compresses outcome variance and inflates the apparent explanatory share of the strongest predictor. The model's predictive strength should therefore be interpreted as TPB performing well within a favourable sample under method conditions that share variance, and not as a context-free estimate of attitude's causal weight.

The non-significance of Perceived Behavioural Control is the most theoretically interesting departure from the prior literature. Several explanations are mutually compatible. Halal storage is a process attribute that the consumer does not directly contract for or operate, in which the financial-capacity component of PBC is therefore loaded onto an indirect payment (a modest price premium) rather than a direct service fee, weakening the financial-capacity signal. Sample affluence may further compress PBC variance. In an urban Klang Valley sample, the modest price premium captured by the WTP construct is unlikely to be financially constraining for the majority. The result also stands in apparent contrast to Ngah et al. (2021) on Halal transportation, where PBC was significant. The divergence is consistent with the visibility logic developed, where transportation is observable (Halal-marked vehicles) and the consumer signal is more direct, storage is invisible and the PBC pathway operates only indirectly through product preference.

The strength of the Attitude pathway, combined with the high inter-correlation between Attitude and Subjective Social Norms and the corresponding upper-range VIFs (4.64 for Attitude, 4.32 for Subjective Social Norms), supports a social-visibility interpretation (Bonne et al., 2007; Terry & Hogg, 1996). When the behaviour itself is not socially observable, the normative pathway operates through internalised community values rather than visible compliance, and part of its variance is absorbed into the Attitude pathway. The Subjective Social Norms coefficient is therefore likely to underestimate the substantive role of community norms in shaping Halal-storage WTP, with much of the normative influence transmitted through Attitude.

The post-hoc demographic analysis identifies Religion as the largest demographic differentiator, with Muslim respondents reporting the highest median WTP. Two features of this finding deserve attention. First, non-Muslim WTP was substantial, where Christian respondents reported a median close to the Muslim median and the "Others" group reported the same median as the Muslim group. This is broadly consistent with prior Malaysian evidence that non-Muslim consumers value Halal attributes for reasons of food safety, supply chain transparency, workplace solidarity in a multi-religious workforce, and a general association of Halal certification with quality (Aziz & Chok, 2013; Lim et al., 2022; Rezai et al., 2010). Second, Buddhist and Hindu respondents reported substantially lower medians, suggesting genuinely divergent value orientations rather than a uniform non-Muslim response and reinforcing the case for further cross-religious work on Halal services. The effects of age, education, occupation, and income, although statistically significant, were small and should be interpreted as exploratory.

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5.2 Theoretical Implications

The study contributes to the Halal supply chain and consumer behaviour literatures along three axes. First, it offers one of the first direct empirical applications of TPB to consumer WTP for a backend, process-attribute Halal service, extending the framework documented by Ngah et al. (2021) for the more visible Halal transportation node to the less visible storage node. The differing PBC results, significant for transportation but non-significant for storage, indicate that visibility moderates the operation of TPB pathways in Halal-logistics contexts, providing a testable proposition for future cross-node comparisons.

Second, the study provides empirical support for the social-visibility thesis (Bonne et al., 2007; Terry & Hogg, 1996) within the Halal-services context. When the focal behaviour is invisible to others, the normative pathway weakens relative to the attitudinal pathway, and its variance is partially absorbed into Attitude. This refines the theoretical understanding of when subjective norms operate as a distinct empirical influence and when they operate through internalised value structures.

Third, the inclusion of non-Muslim respondents alongside Muslim respondents provides a cross-religious comparison that is rare in the Halal WTP literature (Lim et al., 2022; Rezai et al., 2010). The finding of substantial non-Muslim WTP, concentrated among Christian and Others respondents rather than uniformly distributed, opens a research line on how non-religious motivations (food safety, supply chain transparency, multi-religious workplace solidarity) translate into Halal-supportive consumer behaviour.

A methodological contribution is also offered. The combination of HC3-corrected regression, non-parametric inference for demographic comparisons with effect-size reporting, exploratory factor analysis with composite-reliability indices and a transparent treatment of common method variance offers a more conservative analytic template than is typically employed in TPB-Halal research, where reliance on covariance-based inference with limited robustness checks remains common.

5.3 Practical Implications

For Halal third-party logistics (3PL) providers, the findings support investment in dedicated Halal warehousing as a market-supported infrastructure category. Because the underlying consumer WTP is driven primarily by Attitude, with Subjective Social Norms as a secondary channel, market-activation strategies should target the attitudinal pathway through educational content, Muslim-network outreach, social-media campaigns showing the Halal-integrity rationale for dedicated storage and QR-code-based traceability disclosure on packaging that makes the invisible storage attribute visible to the consumer (Ali et al., 2021; Harsanto et al., 2024; Sunmola et al., 2025; Tan et al., 2020).

For JAKIM and the Department of Standards Malaysia, the findings provide a consumer-grounded basis for further refinement of the MS2400 standard family on Halal logistics and for the promotion of a dedicated Halal-storage certification mark distinct from product-level Halal certification. Mandatory disclosure of Halal-storage status on packaging, analogous to country-of-origin or organic-certification disclosure in other domains, could convert an invisible process attribute into a visible product cue and engage the attitudinal pathway documented here.

For Halal-certified brand owners and FMCG firms, the findings support the use of packaging disclosure of Halal-storage compliance as a differentiation cue. Given the dominance of Attitude over Subjective Social Norms in the regression, the brand-communication emphasis should be on consumer education about Halal-integrity benefits rather than on social-conformity framing.

At a societal level, the strengthening of consumer-supported Halal-storage infrastructure improves trust in the integrity of the Malaysian Halal supply chain, reduces cross-contamination risk for Muslim consumers, supports Malaysia's positioning as a global Halal hub and, given the substantial non-Muslim WTP documented in the sample, has potential to be marketed as a general food-safety and supply-chain-transparency asset across religious segments.

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5.4 Limitations and Future Research Direction

The findings should be interpreted in light of several limitations, each of which suggests a productive direction for future research.

First, the geographic scope (Klang Valley) and the use of convenience sampling constrain generalizability of the findings to less urbanised regions of Malaysia and to other Muslim-majority contexts. Multi-regional sampling and probability designs are recommended to corroborate the patterns documented here.

Second, the cross-sectional, single-time-point design does not permit causal inference about the antecedent–outcome relationships. Longitudinal designs and, where feasible, quasi-experimental designs leveraging variation in Halal-storage disclosure on packaging, would strengthen causal claims.

Third, Willingness to Pay was operationalised as a behavioural intention rather than as a monetary valuation. The magnitude of the price premium that consumers would actually pay for Halal-storage-disclosed products is therefore beyond the scope of the present design and should be addressed in future work using discrete-choice experiments (Carlsson & Martinsson, 2001) or auction-based methods (Lusk & Schroeder, 2004).

Fourth, the construct validity evidence, although broadly supportive of the four-factor TPB-WTP structure, showed some cross-loadings between Attitude, Subjective Social Norms and Willingness to Pay items. This is consistent with a well-documented pattern in TPB research where Attitude and behavioural intention share substantial variance. Confirmatory Factor Analysis on an independent sample is recommended to corroborate the factorial structure.

Fifth, common method variance is a residual concern given the single-source, single-time-point design. Harman's single-factor test indicated non-trivial shared method variance ,and although procedural remedies were partially applied, multi-source or multi-method designs would offer a stronger test of the differential TPB pathways.

Sixth, the distribution of responses across the online and on-site collection channels was not separately recorded, precluding channel-equivalence testing. Future dual-channel studies should document the channel of origin and apply non-parametric channel-comparability tests on composite scores before pooling.

Seventh, religiosity and Halal knowledge were not measured as antecedents or moderators. Given the centrality of religion in the demographic analysis, future work should incorporate validated religiosity scales (e.g., Mokhlis, 2009) and Halal-knowledge measures (Ahmad et al., 2015) as antecedents or moderators of TPB pathways.

Finally, replication of the present findings outside the Klang Valley and outside Malaysia, in other Muslim-majority contexts such as Indonesia, the Gulf region and South Asia, would test the boundary conditions of the visibility-moderated pattern documented in this research.

6. Conclusion

This study extended the Theory of Planned Behaviour(TPB) to consumer Willingness to Pay for dedicated Halal storage, a backend, process-attribute service that has received little attention in the Halal supply chain consumer literature. The principal contribution is empirical and conceptual, where it offers one of the first direct applications of TPB to consumer support for an invisible Halal-logistics node, extending the framework from the visible transportation context examined by Ngah et al. (2021) to the less visible storage context. The pattern of the findings refines theoretical understanding of how the visibility of a behaviour conditions may influence the operation of the three TPB pathways.

The practical takeaway is that consumer support for dedicated Halal storage is real, which is present across the surveyed segments and best activated through Attitude-targeted interventions. Visibility-creating

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mechanisms, packaging disclosure, traceability marks, QR-code-based supply-chain verification and a JAKIM-administered Halal-storage certification distinct from product-level Halal certification can convert an invisible process attribute into a visible product cue and thereby reinforce the dominant attitudinal pathway. Moreover, the non-trivial Willingness to Pay observed among non-Muslim respondents indicates that Halal storage can be positioned as a general supply-chain integrity asset rather than exclusively as a religious-compliance asset.

The findings should be understood within the study's boundary conditions, namely the use of a single-city, convenience-sampled, cross-sectional design measuring WTP as behavioural intention rather than monetary valuation. The study is therefore best read as a structural test of the TPB pathways for Halal storage and as a basis for hypothesis development for follow-on work using probability sampling, multi-regional designs, longitudinal observation, and discrete-choice experiments. Future research extending the analysis to other Muslim-majority contexts, incorporating religiosity and Halal knowledge as antecedents, and applying multi-source designs to address common method concerns will further test the robustness and boundary conditions of the patterns reported in this study.

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Conflict of interest statement

The authors declare that this research was conducted in the absence of any self-benefits, commercial or financial interests that could influence the work reported in this paper.

Ethics statement

The study was approved by the Universiti Putra Malaysia Ethics Committee for Research Involving Human Subjects (JKEUPM), reference JKEUPM-2025-466. Informed consent was obtained from all respondents prior to questionnaire administration.

Declaration of generative AI

During the preparation of this work, the author(s) used a generative AI tool to assist with language refinement. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Data availability

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

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Appendix A. Survey Instrument

All items were measured on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

Code	Item Wording	Construct	Source
ATT1	Using halal storage services is important.	Attitude	Adapted from Alam & Sayuti (2011); Bonne et al. (2007)
ATT2	Paying for halal storage services is beneficial.	Attitude	Adapted from Alam & Sayuti (2011); Bonne et al. (2007)
ATT3	I like the idea of paying for halal storage services.	Attitude	Adapted from Alam & Sayuti (2011); Bonne et al. (2007)
SN1	People whose opinions I value (e.g., my family, friends) would approve of me paying for halal storage services.	Subjective Social Norms	Adapted from Alam & Sayuti (2011); Ngah et al. (2021)
SN2	People who are important to me are willing to pay for halal storage services.	Subjective Social Norms	Adapted from Alam & Sayuti (2011); Ngah et al. (2021)
SN3	People whose opinions I value (e.g., my family, friends) expect me to pay for halal storage services.	Subjective Social Norms	Adapted from Alam & Sayuti (2011); Ngah et al. (2021)
PBC1	I have control to pay for halal storage services.	Perceived Behavioural Control	Adapted from Ajzen (1991, 2002); Ngah et al. (2021)
PBC2	I have the resources necessary to pay for halal storage services.	Perceived Behavioural Control	Adapted from Ajzen (1991, 2002); Ngah et al. (2021)
PBC3	Halal storage services are available for me to pay.	Perceived Behavioural Control	Adapted from Ajzen (1991, 2002); Ngah et al. (2021)
WTP1	I am willing to pay for halal storage services.	Willingness to Pay	Adapted from Ahmed et al. (2019); Ag Majid et al. (2021); Ngah et al. (2021)
WTP2	I am willing to pay a premium for halal storage services to avoid contamination with non-halal products.	Willingness to Pay	Adapted from Ahmed et al. (2019); Ag Majid et al. (2021); Ngah et al. (2021)
WTP3	I am willing to pay a higher price for halal storage services to support the halal supply chain industry.	Willingness to Pay	Adapted from Ahmed et al. (2019); Ag Majid et al. (2021); Ngah et al. (2021)
WTP4	I believe that paying more for halal-certified storage services ensures better compliance with my religious beliefs.	Willingness to Pay	Adapted from Ahmed et al. (2019); Ag Majid et al. (2021); Ngah et al. (2021)
WTP5	I am willing to use halal storage services even though choices are limited.	Willingness to Pay	Adapted from Ahmed et al. (2019); Ag Majid et al. (2021); Ngah et al. (2021)

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Authors Contribution

Nik Ridhwan conceptualised the research idea, developed the theoretical framework, designed the survey instrument, conducted the data analysis, and wrote the original draft of the manuscript. Tuan Sidek Bin Tuan Muda contributed to the research methodology, supervised the data collection process, and carried out the review and editing of the manuscript. Abdul Hadi Bin Samsi assisted with the investigation, data collection, validation of findings, and review and editing of the manuscript. All authors reviewed and approved the final version for submission.

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