

THE DIGITAL PAYMENT PARADIGM: EXPLORING CONSUMER PREFERENCES AND FINANCIAL DYNAMICS ON THE USE OF E-WALLETS, DEBIT CARDS, AND CREDIT CARDS

WAI HONG TAN* AND SHEE EN YAP

Faculty of Entrepreneurship and Business, Universiti Malaysia Kelantan, 16100 Kota Bharu, Kelantan, Malaysia.

*Corresponding author: wai.hong@umk.edu.my

<http://doi.org/10.46754/jbsd.2025.09.003>

Received: 7 December 2024

Revised: 9 June 2025

Accepted: 6 July 2025

Published: 15 September 2025

Abstract: This study examines consumer preferences for digital payment methods, namely e-wallets, debit cards, and credit cards, by investigating the influence of perceived security, convenience, and social influence, with monthly expenditure as a potential mediator. The research addresses a gap in the literature by providing a comparative, multi-method analysis grounded in the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB). Accordingly, a quantitative cross-sectional survey was conducted with 200 Malaysian respondents, primarily young adults, and the data were analysed using Spearman's Rank Correlation and Hayes' PROCESS macro for mediation. The results indicate significant positive associations between all independent variables and payment preferences across methods. However, mediation was not supported for e-wallets and debit cards. Nonetheless, for credit cards, monthly expenditure partially mediated the effects of perceived security and convenience on preference. Overall, these findings highlight the direct role of consumer perceptions in shaping payment choices, particularly for credit cards, where behavioural engagement is stronger. In addition, the study offers practical insights for refining digital payment strategies and contributes to a deeper understanding of consumer decision-making in evolving cashless environments.

Keywords: Bootstrapping, correlation, digital payment systems, mediation, spending dynamics.

Introduction

The rapid advancement and widespread adoption of digital payment systems, including e-wallets, debit cards, and credit cards, have transformed the global financial landscape. This evolution is largely driven by consumer demand for speed, convenience, and flexibility in financial transactions. In Malaysia, government-led cashless initiatives and increased smartphone penetration have accelerated the uptake of digital payments, particularly among younger consumers. As a result, these developments have stimulated research interest in understanding consumer preferences and financial behaviour within digital payment ecosystems.

Despite this momentum, consumer preferences remain fragmented across different payment channels, each offering distinct benefits and challenges. E-wallets offer app-based

convenience, instant payments, and cashback incentives, while debit cards promote financial discipline and mitigate debt risk. On the other hand, credit cards offer financial flexibility and loyalty rewards, but they also carry concerns about debt accumulation. To design user-centric payment systems and marketing strategies, it is essential to understand the factors that shape consumer choices across these platforms.

Literature Review

Digital payments, encompassing e-wallets, debit cards, and credit cards, are electronic transactions facilitated by various technologies. Note that each payment method offers unique advantages and challenges, shaping consumer preferences in distinct ways. In particular, e-wallets allow users to perform online purchases, in-store payments,

and peer-to-peer transfers with ease. At the same time, security features, including encryption and biometric authentication, play a critical role in building trust among users (Yang *et al.*, 2021). In Malaysia, government initiatives have further accelerated the adoption of e-wallets such as Boost, GrabPay, and Touch 'n Go e-wallet, all of which include loyalty programmes and rewards (Chea, 2020).

Debit cards, directly linked to users' bank accounts, promote financial control and help users avoid debt accumulation, as spending is limited to available funds (Bachas *et al.*, 2018). Meanwhile, credit cards offer access to revolving credit and provide rewards such as cashback, travel points, and purchase protection, contributing to their perceived value. However, they come with risks of over-indebtedness and interest charges (Nanda, 2021; Agarwal *et al.*, 2023).

From a behavioural perspective, security, convenience, and social influence are consistently cited as critical factors shaping digital payment adoption. Enhanced security, such as encryption and biometric login, builds consumer trust and reduces perceived risks, particularly given rising cybercrime rates (Schuh & Stavins, 2010, 2012). Convenience, including transaction speed, system usability, and platform integration, is another major driver of preference (Alarooj, 2020). Moreover, social influence, such as peer recommendations, digital trends, and normative beliefs, also plays a key role in adoption, particularly among younger consumers (Gunawan *et al.*, 2023).

Although existing studies offer valuable insights, many focus on a single payment method or overlook how these drivers interact through behavioural intermediaries such as consumer expenditure. As Lew *et al.* (2020) and Chan *et al.* (2020) emphasised, comprehensive frameworks are essential for understanding the combined effects of psychological and financial factors across multiple payment types.

Theoretical Framework

This study employs two theoretical lenses to

explain how consumer perceptions shape preferences: The Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB). The TAM (Davis, 1989) posits that perceived usefulness and perceived ease of use influence individuals' intention to adopt new technologies. In this study, convenience and security align with these constructs, suggesting that consumers are more likely to prefer payment methods they find secure and easy to use.

Conversely, the TPB (Ajzen, 1991) complements this by incorporating social norms and perceived behavioural control as predictors of intention. Social influence in this study corresponds to subjective norms, external pressures, or social expectations that guide consumer choices.

Together, these models support the idea that perceptions (security, convenience, social influence) predict preferences, and that monthly expenditure may mediate this relationship as a behavioural reflection of these beliefs.

Problem Statement and Research Objectives

While numerous studies have examined digital payment preferences, most focus on a single method or ignore the mediating effects of consumer behaviour, particularly monthly expenditure. This limits our understanding of the full pathway between perceptions and preferences. Moreover, few comparative studies explore how these relationships vary across multiple payment platforms within a single framework.

Therefore, this study addresses this gap by assessing both direct and mediated relationships between key perceptions and consumer preferences across e-wallets, debit cards, and credit cards in Malaysia. The research objectives include:

1. To examine the direct relationships between perceived security, convenience, and social influence and consumer preferences for e-wallets, debit cards, and credit cards.

2. To assess whether monthly expenditure mediates these relationships.
3. To compare how these factors influence preference across the three payment methods.

Materials and Methods

Research Design and Sampling

This study employs a quantitative cross-sectional survey design to assess consumer preferences for digital payment methods. The target population comprises Malaysian consumers who utilise e-wallets, debit cards, and credit cards for their daily transactions.

A non-probability convenience sampling method was used to recruit 200 participants. Respondents were invited to complete an online questionnaire distributed through popular social media platforms, including WhatsApp and Telegram. While this sampling method facilitates rapid data collection and cost efficiency, it introduces limitations in terms of representativeness (Etikan, Musa, & Alkassim, 2016). Notably, the majority of respondents were young adults and students, which may skew the findings toward digital-native preferences. This sampling choice was also influenced by limited access to a broader demographic under time and resource constraints. Although this restricts generalisability, the sample size exceeds the minimum threshold for mediation analysis using the PROCESS macro and is consistent with sample sizes in similar payment preference studies.

Instrumentation

The online questionnaire comprised four sections. Section A collected demographic information such as age, gender, education level, and employment status. Meanwhile, Section B measured consumer preferences for payment methods (dependent variable) using five-point Likert scales. Following this, Section C assessed the independent variables consisting of perceived security, convenience, and social influence, also using five-point Likert items. Moreover, Section

D captured monthly expenditure (the mediator) using open-ended numeric responses. Note that all constructs were adapted from previously validated studies and demonstrated high internal consistency, as reflected in Cronbach's Alpha values reported in the results section.

Data Collection and Ethical Considerations

The survey was developed using Google Forms and administered anonymously. Participation was voluntary, and informed consent was obtained prior to participation. Additionally, no personally identifiable information was collected, ensuring respondent confidentiality.

As the study involved self-reported data, limitations such as response bias, recall inaccuracies, and social desirability effects must be acknowledged. These are common in behavioural finance studies and were minimised by ensuring anonymity and clarity in question wording.

Data Analysis

Data were analysed using IBM SPSS. Descriptive statistics were used to summarise demographic characteristics. At the same time, reliability testing (Cronbach's Alpha) was conducted to evaluate internal consistency for each construct. To assess relationships between variables, Spearman's Rank Correlation was employed due to the ordinal nature of Likert-scale responses and the non-normal distribution of the data. This nonparametric method is widely recommended for analysing Likert-type survey items, especially when assumptions of normality are not met. Recent studies in related domains have adopted similar approaches. Specifically, Moreno-Menéndez *et al.* (2025) applied Spearman's rho to examine customer experience in digital service environments using ordinal data. Consistent with this, Vinkóczy *et al.* (2024) used Spearman correlation in a FinTech adoption study among Generation Z to address non-normality in Likert-scale responses.

To examine the mediating role of monthly expenditure, Hayes' PROCESS macro (Model 4) was utilised (Hayes, 2017). Specifically, mean scores for each Likert-scale construct were used to enable continuous variable input in the mediation model. Furthermore, bootstrapping with 5,000 resamples was applied to assess indirect effects and generate bias-corrected confidence intervals. This approach provides robust inference even in small to moderate sample sizes and is particularly suitable when normality assumptions are not met.

It is crucial to emphasise that, due to the cross-sectional and correlational nature of this study, no causal claims are made. As such, mediation is interpreted in terms of statistical associations and external factors affecting monthly expenditure. This includes income variation, inflation, or seasonal spending habits, which are acknowledged as uncontrolled influences.

Results and Discussion

The study involved 200 respondents, the majority

of whom were female (78.5%), with males representing 21.5%. Most participants were between 18 and 24 years old (85.5%), and a significant portion were students (82.5%), reflecting the digital-native profile of the sample. In terms of ethnicity, 70.5% were Malay, followed by 23% Chinese, 2.5% Indian, and 4% from other groups. A large majority (82%) had a tertiary education, consistent with the high digital literacy assumed in mobile payment studies.

Reliability Testing

Cronbach's Alpha was calculated for each construct and payment method, with all values exceeding 0.90 (for instance, preference $\alpha = 0.964$ for credit cards; security $\alpha = 0.945$ for debit cards), as outlined in Table 1. These coefficients suggest excellent internal consistency, indicating that the survey items reliably measured each latent construct. This lends support to the construct validity of the research instrument, ensuring the robustness of subsequent analyses.

Table 1: Test of reliability (Cronbach's Alpha), $N = 5$ items for each measured construct

	Preference	Security	Convenience	Social Influence
E-wallets	0.912	0.938	0.932	0.933
Debit Cards	0.911	0.945	0.937	0.946
Credit Cards	0.964	0.955	0.967	0.965

Correlation Analysis

Using Spearman's Rank Correlation, we assessed the associations between the constructs (perceived security, convenience, and social

influence) and consumer preference across the three payment types, as summarised in Tables 2, 3, and 4.

Table 2: Spearman's Correlation and their associated p-values for e-wallets ($N = 200$)

		Security	Convenience	Social Influence
Preference	1.000	.605**(<.001)	.633**(<.001)	.565**(<.001)
Security	.605** (<.001)	1.000	.799** (<.001)	.656** (<.001)
Convenience	.633** (<.001)	.799** (<.001)	1.000	.680** (<.001)

Social Influence	.565			
Preference	.656**	.680**	1.000	
**	(<.001)	(<.001)		
(<.001)				

** . Correlation is significant at the 0.01 level (2-tailed)

Table 3: Spearman's Correlation and their associated p-values for debit cards (N = 200)

	Preference	Security	Convenience	Social Influence
Preference	1.000	.618**(<.001)	.595**(<.001)	.592**(<.001)
Security	.618** (<.001)	1.000	.757** (<.001)	.700** (<.001)
Convenience	.595** (<.001)	.757** (<.001)	1.000	.668** (<.001)
Social Influence	.592** (<.001)	.700** (<.001)	.668** (<.001)	1.000

Table 4: Spearman's Correlation and their associated p-values for credit cards (N = 200)

	Preference	Security	Convenience	Social Influence
Preference	1.000	.597**(<.001)	.639**(<.001)	.577**(<.001)
Security	.597** (<.001)	1.000	.851** (<.001)	.788** (<.001)
Convenience	.639** (<.001)	.851** (<.001)	1.000	.791** (<.001)
Social Influence	.577** (<.001)	.788** (<.001)	.791** (<.001)	1.000

All three predictors presented significant positive correlations with preference across payment types. Notably, convenience demonstrated the strongest association with credit card preference ($\rho = 0.639$), consistent with the “ease-of-use” component of TAM. Meanwhile, security remained influential ($\rho \approx 0.60$ across methods), reinforcing the role of perceived safety in financial technology use. However, social influence was slightly weaker across payments, but still meaningful ($\rho \approx 0.57$ - 0.59), reflecting the impact of subjective norms from TPB. These results align with existing literature that

emphasises convenience and security as core determinants in TAM models (Lew *et al.*, 2020), and social influence as a normative factor for tech adoption, with the effect being moderately consistent across methods.

Mediation Analysis

Using Hayes' PROCESS Model 4 with 5,000 bootstrap samples, we evaluated whether monthly expenditure mediates the relationships between each predictor and payment preference, as outlined in Tables 5, 6, and 7.

Table 5: Direct and indirect effects of independent variables on consumer preference for e-wallets via monthly expenditure

Pathway (E-Wallets)	Direct Effect	Bootstrapped Indirect Effect
Security → Monthly Expenditure → Consumer Preference	0.6291 ($p = 0.0000$)	-0.0026 (BootSE = 0.0134, BootCI = [-0.0137, 0.0402])

Convenience → Monthly Expenditure → Consumer Preference	0.7598 ($p = 0.0000$)	0.0009 (BootSE = 0.0123, BootCI = [-0.0109, 0.0399])
Social Influence → Monthly Expenditure → Consumer Preference	0.7101 ($p = 0.0000$)	-0.0027 (BootSE = 0.0143, BootCI = [-0.0192, 0.0396])

Table 6: Direct and indirect effects of independent variables on consumer preference for debit cards via monthly expenditure

Pathway (Debit Cards)	Direct Effect	Bootstrapped Indirect Effect
Security → Monthly Expenditure → Consumer Preference	0.7209 ($p = 0.0000$)	0.0067 (BootSE = 0.0078, BootCI = [-0.0060, 0.0251])
Convenience → Monthly Expenditure → Consumer Preference	0.7542 ($p = 0.0000$)	0.0066 (BootSE = 0.0078, BootCI = [-0.0049, 0.0260])
Social Influence → Monthly Expenditure → Consumer Preference	0.6617 ($p = 0.0000$)	0.0041 (BootSE = 0.0107, BootCI = [-0.0179, 0.0256])

Table 7: Direct and indirect effects of independent variables on consumer preference for credit cards via monthly expenditure

Pathway (Credit Cards)	Direct Effect	Bootstrapped Indirect Effect
Security → Monthly Expenditure → Consumer Preference	0.6898 ($p = 0.0000$)	0.0388 (BootSE = 0.0159, BootCI = [0.0089, 0.0728])
Convenience → Monthly Expenditure → Consumer Preference	0.6929 ($p = 0.0000$)	0.0390 (BootSE = 0.0140, BootCI = [0.0145, 0.0698])
Social Influence → Monthly Expenditure → Consumer Preference	0.6774 ($p = 0.0000$)	0.0332 (BootSE = 0.0189, BootCI = [-0.0115, 0.0661])

We observed for e-wallets and debit cards, from Tables 5 and 6, that for all predictors (security, convenience, social influence), the indirect effects through expenditure were non-significant (bootstrapped CIs included zero). Therefore, no mediation was noted. That is, purchasing behavior does not explain how perceptions influence preference in these cases.

As for credit cards, based on Table 7, two indirect effects were statistically significant: One that of Security → Expenditure → Preference, with the indirect effect 0.0388 (0.0089 to 0.0728), and another that of Convenience → Expenditure → Preference, with the indirect effect 0.0390 (0.0145 to 0.0698).

These findings suggest partial mediation. Specifically, high perceived security and convenience directly impact credit card

preference and increase monthly expenditure, which in turn reinforces preference. This aligns with TAM and TPB reasoning: Positive perceptions enhance usage intention, which is reflected in actual spending behaviour.

In essence, the non-significant indirect effect for social influence suggests that while peer pressure shapes intentions, it does not consistently affect the spending volume in the credit card context.

Discussion and Practical Implications

Our analyses confirm that perceived security and convenience are the strongest predictors of digital payment preferences, closely aligning with the TAM, particularly the constructs of perceived usefulness and ease of use. Among the three payment methods studied, credit cards exhibited

a unique pattern: Monthly expenditure partially mediated the relationship between perception and preference. This indicates a deeper behavioural commitment when consumers feel secure and find the service convenient. Additionally, this suggests that consumers may prefer credit cards due to direct perception advantages. Since these perceptions are associated with increased usage and spending behaviour, they reinforce the continued preference.

From a practical standpoint, these findings offer several implications for payment service providers. First, rather than focusing on developing entirely new security features such as biometric or multi-factor authentication, which are now standard across platforms, providers should instead refine how security is communicated. For example, emphasising encryption protocols, real-time fraud detection systems, and transparent security practices can reinforce consumer trust. Building on this, notifications and alerts that educate users about how threats are actively mitigated could also enhance perceived control.

Next, operational improvements in User Experience (UX) can further strengthen perceived convenience. For debit card providers, integrating instant transaction notifications and linking accounts to budgeting tools may appeal to financially conscious users. Conversely, e-wallet platforms should optimise for quick load times and ensure frictionless QR code scanning during in-store transactions. Meanwhile, credit card issuers can enhance convenience by partnering with merchants to offer one-tap checkout experiences and automatic digital receipt storage, reducing post-purchase hassles.

In addition, reward strategies should be more personalised and adaptive. Rather than relying solely on generic cashback offers, providers can use spending analytics to deliver targeted incentives aligned with individual user behaviour. For example, offering higher reward rates in frequently used spending categories such as groceries, travel, or online subscriptions may enhance perceived value and encourage sustained

engagement. When it comes to social influence, traditional advertising may be less effective for digital-native users. Instead, providers should consider leveraging micro-influencers and peer recommendation systems, which can create relatable, trust-based promotions. Platforms might also highlight testimonials or real-user stories that reflect shared values and everyday use cases to foster normative acceptance.

Finally, providers, particularly credit card issuers, should deepen user engagement by offering behavioural insights that link spending behaviour to financial wellness. For instance, visual dashboards that illustrate how users are maximising rewards, managing budgets, or improving credit standing can support both usage and perceived financial control. Additionally, sending periodic financial education tips via email or in-app notifications may reinforce long-term trust and brand loyalty. Overall, these improvements can strengthen consumers' perceptions of value, foster meaningful usage, and differentiate platforms in a competitive digital payment landscape.

Conclusions

This study explored the effects of perceived security, convenience, and social influence on consumer preferences for e-wallets, debit cards, and credit cards, using a mediation framework that incorporated monthly expenditure. Drawing on the TAM and TPB, the results demonstrate that all three predictors were significantly and positively associated with digital payment preferences across platforms. Notably, security and convenience emerged as the strongest predictors, with partial mediation effects observed through monthly expenditure in the case of credit cards.

These findings support and extend prior literature, including Alkhawaiter (2020), who emphasised the growing importance of digital trust and usability in financial technology adoption. Our results further reveal that while consumers perceive e-wallets and debit cards as secure and convenient, only credit card use

appears to be closely tied to actual spending behaviour. This highlights a stronger behavioural link between perceived utility and economic activity in credit card adoption. From a practical perspective, the study offers insights for digital payment providers. Rather than introducing entirely new features, providers should focus on refining the communication and integration of existing systems, particularly in terms of UX, targeted rewards, and transparent security assurance. As such, these strategies are more likely to deepen trust and encourage sustained platform use.

Nonetheless, this study is not without limitations. The sample was heavily skewed toward young, educated individuals (predominantly students aged 18 to 24), limiting the generalisability of the findings to broader populations, including older or lower-income users. Furthermore, the use of self-reported, cross-sectional data restricts the ability to make causal inferences. Factors such as income variability, economic conditions, and promotional exposure, which are also identified to influence expenditure, were not controlled in this study.

Therefore, future research should consider more demographically diverse and representative samples, possibly incorporating longitudinal or experimental designs to better capture behavioural dynamics over time. In line with this, expanding the model to include constructs such as perceived risk, trust in institutions, or technological self-efficacy may further enrich our understanding of digital payment adoption in different socioeconomic segments.

Acknowledgements

This paper is an enhanced version of a final-year project by the Bachelor of Entrepreneurship (Commerce) students (SAK25) for the September 2023/2024 session. We thank the students and faculty for their invaluable support and contributions to this research.

Conflict of Interest Statement

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts, and declare the absence of conflicting interests with the funders.

References

- Agarwal, S., Presbitero, A., Presbitero, M. A. F., Silva, A., & Wix, C. (2023). *Who pays for your rewards? Redistribution of the credit card market*. International Monetary Fund. <https://doi.org/10.17016/FEDS.2023.007>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Alarooj, N. (2020). *Which factors influence consumers' choice of payment method when purchasing online?* [Doctoral dissertation, Auckland University of Technology].
- Alkhowaiter, W. A. (2020). Digital payment and banking adoption research in Gulf countries: A systematic literature review. *International Journal of Information Management*, 53, 102102. <https://doi.org/10.1016/j.ijinfomgt.2020.102102>
- Bachas, P., Gertler, P., Higgins, S., & Seira, E. (2018). Digital financial services go a long way: Transaction costs and financial inclusion. *AEA Papers and Proceedings*, 108, 444-448.
- Chan, K. L., Leong, C. M., & Yiong, B. L. C. (2020). Sharing economy through e-wallet: Understanding the determinants of user intention in Malaysia. *Journal of Marketing Advances and Practices*, 2(2), 1-18.
- Chea, C. C. (2020). The challenges and future of E-wallet. In Mehdi Khosrow-Pour, D. B. A. (Ed.), *Encyclopedia of criminal activities and the deep web* (pp. 932-944). IGI Global.

- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1-4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Gunawan, C. M., Rahmania, L., & Kenang, I. H. (2023). The influence of social influence and peer influence on intention to purchase in e-commerce. *Review of Management and Entrepreneurship*, 7(1), 61-84. <https://doi.org/10.37715/rme.v7i1.3683>
- Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.
- Lew, S., Tan, G. W. H., Loh, X. M., Hew, J. J., & Ooi, K. B. (2020). The disruptive mobile wallet in the hospitality industry: An extended mobile technology acceptance model. *Technology in Society*, 63, 101430. <https://doi.org/10.1016/j.techsoc.2020.101430>
- Moreno-Menéndez, F. M., Zacarías-Rodríguez, V. E., Zacarías-Vallejos, S. R., González-Prida, V., Torres-Quillatupa, P. E., Romero-Girón, H., Rada-Vittes, J. F. V., & Huaynate-Espejo, L. Á. (2025). Enhancing customer quality of experience through omnichannel digital strategies: Evidence from a service environment in an emerging context. *Future Internet*, 17(6), 240. <https://doi.org/10.3390/fi17060240>
- Nanda, A. P., & Banerjee, R. (2021). Consumer's subjective financial well-being: A systematic review and research agenda. *International Journal of Consumer Studies*, 45(4), 750-776. <https://doi.org/10.1111/ijcs.12668>
- Schuh, S., & Stavins, J. (2010). Why are (some) consumers (finally) writing fewer checks? The role of payment characteristics. *Journal of Banking & Finance*, 34(8), 1745-1758. <https://doi.org/10.1016/j.jbankfin.2009.09.018>
- Schuh, S., & Stavins, J. (2012). How consumers pay: Adoption and use of payments (No. 12-2). *Working Papers*. <https://doi.org/10.5430/afr.v2n2p1>
- Vinkóczi, T., Idziak, E., Tamás, B., & Kurucz, A. (2024). Tech titans: Generation Z's role in the FinTech evolution. *Journal of Infrastructure, Policy and Development*, 8(10), 8201.
- Yang, M., Mamun, A. A., Mohiuddin, M., Nawi, N. C., & Zainol, N. R. (2021). Cashless transactions: A study on intention and adoption of e-wallets. *Sustainability*, 13(2), 831. <https://doi.org/10.3390/su13020831>