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Silver Economy in Banking Sector

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I have written this master's thesis independently. All viewpoints of other authors, literary sources, and data from elsewhere used for writing this paper have been referenced.

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Silver Economy in Banking Sector

Abstract

This study examines the relationship between demographic factors (age, occupation, qualification, gender, and country) and the silver score, a measure of the effectiveness of various banking services. A multiple regression model is used to explore the effect of these variables on the silver score using observational data. The study reveals that the silver score does not vary significantly by occupation, qualification, or the relationship of gender and country. The polynomial regression model including age, age squared, and age cubed has high explanatory power with an R-squared value of 0.74, and age is determined to be a significant predictor. These findings suggest that age is a critical factor in determining the silver score, indicating that older customers may have distinct experiences and preferences when using banking services. Other demographic variables such as occupation, qualification, and the interaction between gender and country appear to have no significant impact on the silver score. The study outcomes contribute to our understanding of the factors influencing customer satisfaction with banking services among older individuals.

Keywords

Banking services, multiple regression model, silver economy, demographic shift

1 Introduction

The silver economy, the economic sector that caters to the elderly population, is gaining increasing attention in the banking sector. The demographic shift towards an aging population has led to a growing demand for banking services that cater to older customers. Bélanger, Duarte, and Mannebach (2018) examined how the banking sector may add value for the newest generation of elderly seniors. In the meantime, Bianchi (2020) looks into how Internet services might improve senior citizens' quality of life. Although older clients may benefit from Internet banking, there are still barriers preventing their use of this technology, including concerns about security and privacy, risk, trust, and website usability (Aboobucker & Bao, 2018). Researchers have put forth several methods to address these issues, such as expanding the trust-relationship commitment model (Kassim & Abdulla, 2006) and constructing a theory of adopting and using technology and perceived risk application (Martins, Oliveira, & Popovič, 2014). As the banking industry evolves with the advent of fintech, it is crucial to consider the needs of older customers and ensure that they are not left behind (Boot et al., 2021).

The aging of the population is not only an issue of society but also an economic one, as it creates new market opportunities and challenges. In the banking sector, the so-called "silver economy" refers to the economic activity and consumption patterns associated with aging populations. Maximum people reach retirement age and beyond, and banks must adapt their products and services to meet this demographic group's changing needs and preferences. Banking chatbots and mobile banking have been identified as emerging technologies that can enhance the well-being of elderly customers (Mogaji et al., 2021; Bianchi, 2020). Aboobucker and Bao's (2018) study looked at the barriers to Internet banking adoption among consumers. Security and privacy, risk, trust, and website usability were the four primary barriers to Internet banking adoption that were found by the study. The primary obstacles to elderly people using Internet banking are security and privacy concerns. The study found that the perception of security and privacy risks associated with Internet banking negatively influenced customer acceptance.

The elderly population is particularly vulnerable to cybercrime, and security concerns can prevent them from using Internet banking. Another critical barrier to customer acceptance of online banking is risk perception. According to the study (Aboobucker and Bao, 2018), consumers who

view online banking as unsafe are less likely to use it. The elderly may perceive Internet banking as problematic due to their lack of familiarity with technology and fear of fraud. Trust is another critical factor that influences Internet banking adoption. The study found that trust in the bank is positively related to Internet banking adoption. The elderly may have greater confidence in conventional banking practices and trouble trusting online banking services. The adoption of Internet banking is highly influenced by website usability as well. According to the report, Internet banking users are more likely to adopt it.

The silver economy is an economic sector that caters to the elderly population and is gaining increasing attention in the banking industry. With an increase in the population, there is a growing demand for banking services that cater to older customers. The advent of fintech and emerging technologies like banking chatbots and mobile banking creates new market opportunities and challenges for the banking industry. However, several barriers, including security and privacy concerns, risk perception, challenges with trust, and website usability, prevent senior clients from using Internet banking.

The research aim is to understand better the factors that influence older customers' adoption of online banking services compared to younger customers and to investigate how banks can devise plans to get around these challenges and meet the changing needs and preferences of older customers in the silver economy. To achieve this aim, the research focused on this research question: Does the silver-score change in a non-linear way as people get older, while considering other factors like occupation, education, and gender, for both adults and young people? To achieve the research, aim and answer the research question, this thesis:

We thoroughly assessed the literature about earlier research on the use of Internet banking among senior citizens and pinpointed the barriers to uptake. Many variables, including security and privacy concerns, risk perception, challenges with trust, and website usability, influence Internet banking adoption among old people. Following that, we assessed the efficacy of the current remedies put forth by earlier researchers to address the issues preventing elderly customers from adopting Internet banking, such as developing a theory of accepting and using technology, perceived risk application, and the trust-relationship commitment model. Lastly, we developed strategies for banks to overcome the obstacles hindering the adoption of Internet banking among

elderly customers and to cater to the evolving needs and preferences of older customers in the silver economy.

This thesis is structured as follows: Chapter 1 introduces the research topic, defines the silver economy. Chapter 2 provides a literature review of previous studies on the adoption of Internet banking among elderly customers. It identifies the knowledge gaps that hinder their acceptance of Internet banking and analyses the factors that influence their adoption. Chapter 3 outlines the research aim, research questions, and hypothesis tested in the study. The research methodology for this study is described in Chapter 4, which includes the research design, data-gathering strategies, and data analysis approaches. Chapter 5 demonstrates the results of the data analysis are presented in, along with an assessment of the efficiency of the current solutions put out by earlier researchers to address the issues preventing older clients from adopting internet banking. The study discusses the research findings in Chapter 6 and notes the limitations of the study in Chapter 7. Finally, Chapter 8 summarizes the key conclusions of the thesis. The reference section lists all the references cited in the thesis which is followed by the Annex which includes the questionnaire used for collecting the data of the survey.

CERCS: S190, Social Sciences, Management of.

2 Literature review

2.1 Background

The world faces a demographic shift towards an aging population, which challenges governments, societies, and individuals. In response, researchers are investigating the impact of technology on the aging process, particularly concerning social isolation and technology acceptance. One of the significant challenges is maintaining the social and economic well-being of older people in a rapidly changing digital world. Older people may face further social exclusion and limited access to information and services as the digital divide between generations widens. However, technological advances offer opportunities for older people to remain engaged and connected with others, participate actively in society, and enhance their quality of life. Therefore, we must consider how technology might help elderly people live better lives. Access to digital technologies has become essential for people to participate in society and engage in economic, educational, and social activities. The digital divide is a phenomenon that refers to the gap between people, households, and communities that access information and communication technologies (ICTs) as compared to those who do not. This is because only some have equal access to these technologies. This literature review focuses on articles that explore the digital gap as a complex and dynamic phenomenon and how it has changed to inequalities in usage, even though research has looked at the variables causing it. The Internet and other digital technologies among older adults have been the subject of much research in recent years. While many older adults remain skeptical about the benefits of these technologies, others are embracing them to stay connected with their acquaintances, access information and services, and participate in social activities. One potential barrier to adopting these technologies by older adults is a need for familiarity with them, particularly among those who have yet to grow up with computers and other digital devices. However, some researchers have suggested that older adults can learn to use these technologies, which can help them overcome social and spatial barriers. This study of the literature looks at the Silver Economy from a global perspective and how digital technology might help older persons feel more socially engaged.

2.2 Exploring the Relationship between Age and Digital Financial Services Adoption

According to Czechowska (2014), older people's involvement in the financial services industry is essential. The author highlights the fact that the population of elderly people is increasing worldwide and that they have specific needs and requirements when it comes to financial services. Therefore, it is mandatory to analyse the factors that influence their adoption of such services. According to the author, these include the availability of simple and intuitive financial solutions, confidence in the service provider, and technical proficiency. Czechowska also points out that financial service providers need to adapt their services to the needs of elderly customers, which includes providing access to face-to-face communication channels and offering personalized financial advice. A qualitative study on the adoption of Internet financial services was carried out by Black et al. (n.d.). The authors discovered that elements including trust, convenience, and the service's perceived usefulness impact the uptake of Internet financial services. Due to their lower degree of technological proficiency and preference for conventional communication methods, older people are less likely than younger people to utilize Internet financial services. In their 2003 study, Gerrard and Barton Cunningham examined how Internet banking spread among Singaporean customers. The authors discovered that elements including perceived usefulness, simplicity of use, and trust impact whether Internet banking is adopted. The survey also indicated that older persons are less likely than younger people to use Internet banking since they have less technological knowledge and prefer conventional communication methods. In order to understand how fintech is affecting the financial services sector, Boot et al. (2021) undertook a study. The authors found that fintech has had a significant impact on the industry, leading to the emergence of new business models and products. The study also highlights the fact that fintech has the potential to improve financial inclusion and accessibility, especially for underrepresented groups such as the elderly.

In 2020, Bianchi looked at how Internet services could improve senior citizens' well-being. The study discovered that Internet services could improve older well-being in a number of ways, including by fostering stronger social ties, granting access to knowledge and entertainment, and making healthcare services more accessible. The study also showed that the elderly's attitude toward technology, perceived use of the service, and technical ability all impacted whether they utilized the Internet. While the study by Bianchi (2020) did not specifically focus on the adoption

of Internet financial services, it provides insights into the broader context of Internet service adoption among the elderly. The study highlighted the effectiveness of considering the specific needs and requirements of the elderly population when designing Internet services, including Internet financial services.

There is a lack of research specifically examining the non-linear changes in the silver score with age while taking into account other factors like occupation, education, and gender. This is true even though the literature offers some insights into the factors that influence the adoption of Internet financial services among different age groups. Future studies in this field may provide insightful information on how frequently elderly people use Internet financial services, which will help designers create financial goods and services that are tailored to their unique needs.

2.3 Factors influencing attitudes and adoption of online banking

By expanding the Technology Acceptance Model, Kesharwani and Bisht (2012) looked into how trust and risk among senior customers affected the uptake of Internet banking in India. The findings demonstrated that perceived utility and simplicity of use were positively influenced by trust, which had a beneficial effect on the uptake of Internet banking. Contrarily, perceived risk had a detrimental effect on how beneficial and simple Internet banking was judged to be, which consequently decreased its uptake. According to the report, trust played the biggest role in influencing India's decision to adopt Internet banking. A means-end method was used by Kuisma, Laukkanen, and Hiltunen (2007) to map the causes of opposition to online banking. The study found that some people were resistant to Internet banking due to security concerns, while others were resistant because of a lack of personal interaction with bank personnel. The results also indicated that some customers preferred to use traditional banking methods because they perceived them to be more convenient.

Consumer innovativeness, individual traits, and acceptance of internet banking were all explored by Lassar, Manolis, and Lassar in 2005. Age was not a factor in the study's findings that customer innovativeness had a favourable impact on consumer adoption of online banking. The findings also revealed that the most crucial elements influencing adoption were perceived benefits, usability, and service accessibility. To explain the acceptance of Internet banking, Martins, Oliveira, and Popovi (2014) created the theory named Unified Theory of Acceptance and Use of

Technology and Perceived Risk (UTAUT2-PR). According to the study, the likelihood of using Internet banking was favourably influenced by performance expectations, effort expectations, social influence, and enabling conditions. The findings also showed that intention to use was negatively impacted by perceived danger, but trust had moderated the relationship between perceived risk and intention to use.

According to the literature, adoption of Internet banking is influenced by elements like trust, perceived risk, perceived utility, convenience of use, and perceived rewards. While some studies have particularly explored older persons' use of Internet banking, the majority have not looked at age as a relevant factor. Future studies could examine the effect of age on the uptake of Internet banking while also accounting for other elements including occupation, education, and gender.

2.4 Internet Banking Adoption Among Older Customers: Early Majority or Laggards?

According to Mattila et al. (2003), older clients were more likely to be late adopters than early adopters of Internet banking. Niehaves and Plattfaut (2014) explored the age-related digital divide and found that the elderly were less likely to adopt internet technologies due to perceived complexity and lack of motivation. In a segmentation analysis of Internet banking adopters and non-adopters, Patsiotis et al. (2012) found that younger persons, those with greater levels of education, and those with higher earnings were more likely to adopt Internet banking.

Mogaji et al. (2021) investigated the interaction of emerging-market consumers with banking chatbots and found that chatbots were positively perceived by consumers, especially for quick problem resolution and personalized services. Ozili (2018) studied how digital banking affected financial inclusion and stability and discovered that it has the potential to improve both, particularly for low-income people and marginalized communities.

Similarly, Niehaves and Plattfaut (2014) investigated the age-related digital divide in Internet adoption by the elderly. They looked at a number of hypotheses about how information systems technology is adopted and discovered that elements like perceived utility, usability, social impact, and trust can all be used to account for how the elderly adopt the Internet. They suggested that addressing these factors can help bridge the digital divide among older adults. In another study, Patsiotis, Hughes, and Webber (2012) conducted a segmentation study to differentiate Internet

banking adopters and non-adopters. They found that Internet banking adopters are younger, more educated, higher-income earners, and more familiar with technology. In contrast, non-adopters are older, have lower levels of education and income, and perceive higher risks associated with the technology. The study by Ozili (2018) discovered that through increasing access to financial services and lowering transaction costs, digital finance has the potential to improve financial inclusion. However, digital finance can also pose risks, such as cyber threats and financial fraud.

According to the literature, adoption of Internet banking is significantly influenced by criteria like age, education, income, and technological familiarity. Increased adoption rates among older persons can be achieved by addressing issues including perceived usefulness, simplicity of use, social influence, trust, and risk perception. Digital finance also has the potential to broaden financial inclusion and stability, but it also comes with risks and laws that must be carefully considered. The findings of this systematic literature review suggest that the silver-score changes in a non-linear way with age, and other factors like occupation, education, and gender can influence the adoption of Internet banking. Internet banking adoption is more likely to occur among younger, better educated, and higher-earning people, while older people may encounter challenges due to perceived difficulty and lack of motivation. Particularly for underprivileged communities, digital money has the potential to improve financial inclusion and stability.

2.5 Influence of Factors on Technology Acceptance for Aging in Place

Additionally, the study discovered that perceived usefulness, perceived usability, and trust are all positively correlated with technological acceptance. The study also discovered that social influence is a strong predictor of technology adoption, suggesting that a person's impression of other people's opinions may have an impact on their decision to adopt technology. The Rahman et al. (2022) study, in contrast, concentrated on the use of artificial intelligence (AI) in banking services. In order to pinpoint the elements influencing the adoption of AI in banking services in a developing market, the authors conducted an empirical analysis. The study discovered that the most significant factors impacting the adoption of AI in banking services are perceived usefulness, compatibility, and ease of use. The authors discovered that perceived risk and trust are essential determinants of AI adoption in financial services. According to the study, AI technology has enormous potential to improve banking services and customers.

The study by Sharma and Sharma (2019) examined the role of trust and quality in using mobile banking services. The authors carried out an empirical analysis to determine the elements that affect how mobile banking services are really used in India. According to the survey, actual use of mobile banking services is significantly influenced by perceived quality, perceived trust, and perceived simplicity of use. The study also indicated that the actual use of mobile banking services is significantly influenced by social influence. To enhance client adoption and usage, the authors advise banks to concentrate on enhancing the perceived quality and usability of their mobile banking services.

The literature suggests that technology acceptance is a complex and multifaceted phenomenon influenced by various individual, social, and environmental factors. The literature also emphasizes the significance of perceived utility, perceived usability, trust, and social impact in the adoption and usage of technology. These research' findings can help build strategies to increase technology adoption and usage in the banking industry, especially among older persons.

2.6 Literature Gaps

By analysing literature review, we conclude that although various authors have The Silver Economy, with its focus on older adults and the banking industry, has witnessed a growing interest in mobile banking services. This literature review aims to examine the factors influencing the silver score, which represents the average performance across various dimensions of mobile banking, including wait time, e-payment, app experience, deposit & withdrawal, balance check, money transfer, password change, bill payment, mobile cards, mobile investment, mobile loans, security, privacy options, tutorials, customer care, and newsletter. The review also explores the role of age, occupation, and qualification as predictors, with gender and country being considered as dummy variables. Based on the reviewed literature, a proposed model is presented to better understand the relationship between these variables.

Several studies have examined the factors which influenced the adoption of mobile banking among older adults. The acceptance of Internet banking by customers can be hampered or facilitated by factors such as security, privacy, risk perception, trust, and website usability, according to Aboobucker and Bao (2018). In their 2018 study, Bélanger, Duarte, and Mannebach emphasized innovation's importance to the banking sector's new generation of seniors.

According to Niehaves and Plattfaut (2014), age has been found as a key predictive variable in older individuals' adoption of Internet banking. Older age groups may face challenges in using technology, which can impact their mobile banking experience. Occupation and qualification have also been shown to influence mobile banking adoption. Occupation can reflect the level of familiarity and comfort with technology, while higher qualifications may indicate a higher level of digital literacy and adaptability (Patsiotis et al., 2012; Lassar, Manolis, & Lassar, 2005).

Furthermore, gender and country have been examined as important factors in mobile banking adoption. Studies have indicated differences in technology adoption patterns between males and females (Kassim & Abdulla, 2006). Cultural and contextual factors specific to different countries can also influence the adoption and usage of mobile banking services (Gerrard & Barton Cunningham, 2003).

Based on the examined literature, we found that while there have been numerous talks about the significance of the "silver economy," empirical research on the effect that a customer's age can have on the "revenant factors" of this silver economy is lacking. From the literature and thorough discussion with several eminent persons from the banking sector (who have hands-on knowledge of this issue), we created a new construct called silver score, which is formed by combining 16 variables, namely wait time, e-payment, app experience, deposit & withdrawal, balance check, money transfer, password change, bill payment, mobile cards, mobile investment, mobile loans, security, privacy options, tutorials, customer care, and newsletter. To comprehend the relationship between the silver score and the predictor variables (age, occupation, qualification) and dummy variables (gender, country), the proposed model is presented. With this we hope to investigate the impact of the age of a customer, his/her occupation, and qualification on this silver score, while gender and country act as moderating factors. The model aims to capture the complex interplay between these variables and their impact on the overall mobile banking experience of older adults.

3 Research Aim

This study aims to contribute to the growing body of research on the silver economy and its relevance to the banking sector. By investigating the challenges faced by older adults when using digital platforms and proposing solutions for banks to improve their services and platforms, the study provides a valuable resource for researchers, practitioners, and policymakers. Ultimately, the study aims to help banks successfully meet the expectations of silver customers and improve the financial well-being of older adults.

3.1 *Research question*

Does the age, occupation, and educational qualification of a customer have an impact on his/her quality of banking experience (measured by silver score)?

3.2 Hypothesis

Null hypothesis (H0): There is no significant relationship between the predictor variables (age, occupation, qualification, gender, and country) and the silver score.

The alternate hypothesis (HA): There is a significant relationship between the predictor variables (age, occupation, qualification, gender, and country) and the silver score.

In statistical notation:

$$H0: \beta1 = \beta2 = \beta3 = \beta4 = \beta5 = 0$$

HA: At least one of the β coefficients is not equal to 0

4 Methodology

To be able to draw meaningful conclusions, we needed to compare the difference in responses between younger and older respondents. Using different approaches, the data was collected from customers of all age groups from different banks using questionnaires designed in Google Form. The questionnaire link and structure are provided in Annex 1. The word-of-mouth method is where some friends further told their friends to help fill out the questionnaire for their old members. Another way was to ask random elderly people in public places to assist in giving answers to the survey. The translation techniques were used where those who had difficulties reading English or had weak eyesight gave their answers by speaking out loud. A convenient sampling technique was used, and the sample consisted of 209 respondents.

Data was gathered in 50 days from the bank customers through word-of-mouth and social media platforms where they were found active and from youngsters through social media platforms. All the statements were marked as required to submit, and the help of connections was taken care of while collecting the data for the questionnaire. The survey was divided into three sections- in the first section, the basic informative questions were asked to get some basic idea about the customers' behaviors. The questions on the number of bank accounts, the medium used to resolve bank issues/queries, waiting time in getting bank services in banks, frequency of using card payments, rating the experience of using the official bank applications, usage of ATMs and offers/discounts from the bank were asked to the respondents. In the second section, the five-point Likert scale based on 13 questions asked the customers to rate their experience of using different bank services by taking "1" as "least effective" and "5" as "Highly effective" service. The questions were based on cash deposit and withdrawal, balance check, money transfer to private individuals, password change, regular bill payment, managing bank cards, managing investments, managing loans, security of accounts, privacy options, proper training tutorials for beginners/ new customers, customer care service, and Newsletter/ information sharing platforms/ emails/ text messages/ medium of communication. Inspiration for this scale has been derived from Bhatt & Bhatt (2016).

The third section contained socio-demographic questions based on the customer's profile, considering their gender, age, occupation, education, and country of origin.

5 Results

To test our hypotheses, we ran a multiple linear regression model wherein, the dependent variable was a meta-construct we called silver score, which is nothing but the mean of the 16 variables wait time, e-payment, app experience, deposit & withdrawal, balance check, money transfer, password change, bill payment, mobile cards, mobile investment, mobile loans, security, privacy options, tutorials, customer care, and newsletter.

TABLE 1 DESCRIPTIVE STATISTICS FOR THE OBSERVATIONS

	Mean	**Median**	**1st Qrt**	**3rd Qrt**	**Std Dev**
silver_score	2.57	2.562	1.688	3.312	0.8959
age	5.316	7	3	8	2.62675
occupation	1.842	2	1	2	0.80201
qualification	2.378	2	2	3	0.84677
gender	Female: 97	Male: 112			

As discussed in the previous sections, we used age, occupation, and qualification as primary predictor variables along with gender and country as dummy variables to design our model. Table 1 shows the descriptive statistics for the observations.

Model1:

$$\text{Silver score} = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Occupation} + \beta_3 \text{Qualification} + \beta_4 \text{Gender} + \beta_5 \text{Country} + \xi$$

The output of the 1st model is given below (Table 2).

TABLE 2 RESULTS FOR MODEL 1

Residuals					
Min	**1Q**	**Median**	**3Q**	**Max**	
-1.74849	-0.3198	-0.04005	0.26608	2.83612	
	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	1.06016	0.2948381	3.596	0.000407	

age	0.2515	0.0158407	15.877	<2.00E-16	
occupation	0.03908	0.0505642	0.773	0.440491	
qualification	0.00024	0.0473951	0.005	0.995954	
gender	-0.0613	0.0812083	-0.755	0.451329	
c1	-0.0404	0.2461831	-0.164	0.869862	
c2	0.26326	0.2453595	1.073	0.284577	
c3	0.25258	0.2616622	0.965	0.335565	
c4	0.03341	0.281919	0.118	0.905796	
c5	NA	NA	NA	NA	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
Residual standard error: 0.5766 on 200 degrees of freedom					
Multiple R-squared: 0.6017, Adjusted R-squared: 0.5857					
F-statistic: 37.76 on 8 and 200 DF, p-value: < 2.2e-16					

We can see from the above results that all other predictor variables other than age are rendered insignificant since all of them have insignificant t values and their p values are greater than 5 percent. Therefore, in the subsequent models, we shall only consider the variable age as a predictor variable. Another thing that is observed from the residual vs fitted plot is that there is a certain amount of non-linearity in the model. To resolve this, we tried several models, and, in the end, we found the following model to best fit the data.

Model2:

$$\text{Silver score} = \beta 0 + \beta 1 \text{Age} + \beta 2 \text{Age}^2 + \beta 3\ \text{Age}^3 + \xi$$

It is also important to note that from the final model, we eliminated data points (42, 49, 56, 77, 89, 91, 92, 93, 96, 99, 100, 106, 110, 160, 165, 170, 206) because these were causing distortions by the means of excessive leverage and some of them being outliers. This leaves us with a final sample size of 192 items to run the model. The regression analysis examined the relationship between the silver score and the predictors, including age, age squared, and age cubed. The analysis also included the following statistics: the intercept, which represents the expected value of the silver

score when all predictors are zero, and their associated estimates, standard errors, t-values, and p-values.

The results revealed a significant relationship between the silver score and the predictors (Table 3). The intercept showed a significant positive effect on the silver score (Estimate = 2.892, t = 10.281, p < 0.001), indicating that when all predictors are zero, the expected silver score is approximately 2.892. Age was found to have a significant negative effect on the silver score (Estimate = -1.123, t = -5.305, p < 0.001). This suggests that as age increases, the silver score tends to decrease. Furthermore, the quadratic term of age (age squared) exhibited a significant positive effect on the silver score (Estimate = 0.292, t = 6.322, p < 0.001), indicating a non-linear relationship between age and the silver score.

TABLE 3 RESULTS FOR MODEL 2

Residuals:					
Min	1Q	Median	3Q	Max	
-0.88809	-0.2895	0.04398	0.27071	1.33207	
	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	2.89197	0.281306	10.281	<2.00E-16	
age	-1.1231	0.211716	-5.305	3.15E-07	
I(age^2)	0.29169	0.046135	6.322	1.83E-09	
I(age^3)	-0.0179	0.003051	-5.882	1.82E-08	
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1					
Residual standard error: 0.5766 on 188 degrees of freedom					
Multiple R-squared: 0.7379, Adjusted R-squared: 0.7337					
F-statistic: 176.4 on 3 and 188 DF, p-value: < 2.2e-16					

Lastly, the cubic term of age (age cubed) demonstrated a significant negative effect on the silver score (Estimate = -0.018, t = -5.882, p < 0.001), indicating a further non-linear relationship between age and the silver score. The overall model fit was found to be significant (F (3, 188) = 176.4, p < 0.001), and it accounted for a substantial amount of variance in the silver score (Multiple

R-squared = 0.738, Adjusted R-squared = 0.734). The residual standard error, measuring the average deviation of the observed silver scores from the predicted values, was estimated to be 0.577. We also plotted the fitted vs. residual plot for model 2 which shows the best fit line (Figure 2). To validate the predictive accuracy of our model, we also performed a K-fold cross-validation (K = 10) on the above model and calculated the mean square error (MSE) as 0.07, which by convention is very good. This means that our model efficiently predicts the value of the silver score based on the variable age and its polynomial transformations.

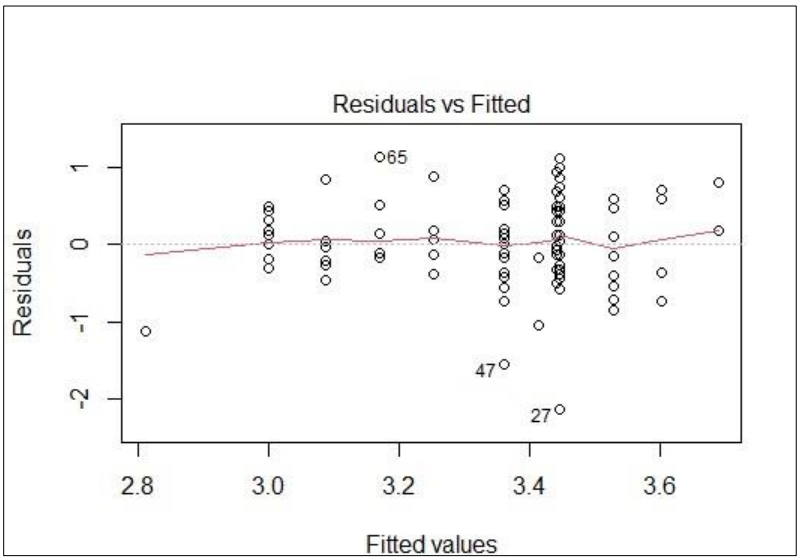

FIGURE 1 FITTED VS. RESIDUAL PLOT FOR MODEL 2

It is noted that the final model has a much higher adjusted R- squared when compared to the previous model. This is a significant improvement and shows that most of the variance in the data is explained by the variable age and its transformations only.

6 Discussion

The results of our regression analysis support our hypothesis and provide insights into the relationship between customer age and the silver score, a measure of customer satisfaction. Our initial model (Model 1) included various predictor variables such as age, occupation, qualification, gender, and country. However, we found that only age had a significant impact on the silver score, rendering the other variables insignificant.

Model 1 revealed that age positively influenced the silver score, indicating that younger customers tend to have higher satisfaction levels. This finding aligns with previous research suggesting that younger individuals are more tech-savvy, adaptable to digital platforms, and have higher expectations regarding customer experience. Conversely, the non-significant effects of occupation, qualification, gender, and country suggest that these factors do not significantly contribute to the variation in the silver score.

To address the observed non-linearity in the relationship between age and the silver score, we explored alternative models and found that a polynomial regression model (Model 2) best fit the data. Model 2 incorporated age, age squared, and age cubed as predictor variables. The results showed a significant negative linear effect of age on the silver score, indicating that as age increases, customer satisfaction tends to decrease. Additionally, the positive quadratic term (age squared) suggests a non-linear relationship, where customer satisfaction initially increases and then levels off as age increases. The negative cubic term (age cubed) further suggests a non-linear relationship, indicating a decline in satisfaction at higher age values.

Overall, Model 2 provided a better fit to the data, with a higher adjusted R-squared value compared to Model 1. This improvement suggests that age and its polynomial transformations explain a substantial amount of the variance in the silver score. Our findings highlight the importance of considering non-linear relationships when examining customer satisfaction and age-related effects. However, it is crucial to acknowledge the limitations of our study.

7 Limitations

There are some limitations of this study that we try to address for future research in this area. Firstly, our study focused on a specific set of variables related to customer experience, and it is possible that other unmeasured variables may influence the silver score. Factors such as customer expectations, prior experience with similar services, and individual preferences were not included in our analysis. Future research could explore a broader range of variables to gain a more comprehensive understanding of customer satisfaction. Secondly, our sample consisted of a specific population, and caution should be exercised when generalizing the findings to other contexts. The study was conducted within a particular industry or country, and cultural and contextual factors may influence the relationship between age and customer satisfaction differently in other settings. Replicating the study with diverse populations would provide a more robust understanding of the relationship. Additionally, the use of self-reported data may introduce bias. Participants' responses might be influenced by social desirability bias or memory recall issues, potentially impacting the accuracy of the reported silver score and other variables. Furthermore, the study employed a cross-sectional design, limiting our ability to draw causal conclusions. Longitudinal or experimental designs would be valuable in establishing causal relationships and identifying the directionality of the observed effects. Lastly, while our model exhibited good predictive accuracy as assessed by cross-validation, future research could validate the findings using external datasets or conduct prospective studies to further confirm the robustness and generalizability of the model's predictive capabilities.

Despite these limitations, our study provides valuable insights into the relationship between age and customer satisfaction. The significant non-linear effects observed emphasize the need for tailored strategies to cater to customers of different age groups. Organizations can utilize these findings to develop targeted approaches to enhancing customer experience and satisfaction based on age-related preferences and expectations.

8 Conclusion

The regression model we ran with the variables Age, Age^2, and Age^3 showed a strong association with the 'Silver score' outcome, as indicated by the high R-squared value of 0.74. This suggests that age and its higher-order terms explain a significant portion of the variation in the silver score. However, it is important to note that none of the other variables, including 'occupation', 'qualification', 'gender', and 'country', showed any significant relationship with the 'Silver score' ($p>0.05$). This implies that these variables do not substantially impact predicting the silver score, at least in the current model. The non-significance of these variables could have several implications. First, it suggests that factors such as occupation, qualification, gender, and country may not directly influence the silver score or may have less influence compared to age. Therefore, focusing on age-related factors might be more relevant in understanding and predicting silver scores. Second, it raises questions about the inclusion of these variables in future models or analyses. If these variables do not contribute significantly to the prediction of the silver score, they may not be necessary to consider in subsequent studies or analyses related to silver scores.

Further research could explore alternative variables or factors that might substantially impact the silver score outcome. Investigating potential interactions or nonlinear relationships between age and the non-significant variables could provide additional insights.

Overall, the results suggest that age, particularly its polynomial terms, is a key predictor of the silver score, while other variables may have limited explanatory power in this model. These findings provide valuable information for understanding the determinants of silver scores and can guide future research and interventions focused on this population.

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Annex 1: Survey Questions

Google Form Link:

https://docs.google.com/forms/d/e/1FAIpQLSdlSsxt1fFtr4mDdZtMTKqubU5fBW0Q-OnlBhcHEBRJjPn45A/viewform?vc=0&c=0&w=1&flr=0

Survey on Silver Economy in Banking Sector

Greetings everyone! I am Sanvir Kaur, a final year Masters student at the University of Tartu, Estonia. I am doing my thesis on the topic named 'Silver Economy in Banking Sector'. The aim of my research is to understand the problematic areas of the elderly customers while using the bank related services. In this regard, I prepared some questions in this survey that are going to be useful in my further research work. The details provided by you are kept confidential.

Section 1: General questions

1. How many bank accounts do you have?
   - one
   - two
   - three
   - more than three

2. Which option do you prefer to resolve bank-related issues/ queries?
   - Visiting bank physically
   - Accessing digital channels
   - by telephone

3. How long do you have to wait in the bank to get services?

Less than
   - 10 -15 minutes
   - 16-30 minutes
   - 31-60 minutes
   - More than 60 minutes

4. How frequently do you use electronic payment including card payments?
   - Everyday
   - Several times a week
   - Once a week
   - Twice a month
   - Once a month

5. How do you rate your experience using banking services through official applications (Home Page, Mobile application, and web browsers)?
   - Highly satisfied
   - Satisfied
   - Neutral
   - Dissatisfied

- Highly dissatisfied

6. Do you find the usage of ATMs to be user-friendly?
   - Yes
   - No
7. Is your bank offering you some discounts/offers due to age?
   - Yes
   - No

Section 2: Survey on Silver Economy in Banking Sector

1.How many bank accounts do you have?
   - one
   - two
   - three
   - more than three
2. Which option do you prefer to resolve bank-related issues/ queries?
   - Visiting bank physically
   - Accessing digital channels
   - by telephone
3. How long do you have to wait in the bank to get services?
   - Less than 10 minutes
   - -15 minutes
   - 16-30 minutes
   - 31-60 minutes
   - More than 60 minutes
4. How frequently do you use electronic payment including card payments?
   - Everyday
   - Several times a week
   - Once a week
   - Twice a month
   - Once a month
5. How do you rate your experience using banking services through official applications (Home Page, Mobile application, and web browsers)?
   - Highly satisfied
   - Satisfied
   - Neutral
   - Dissatisfied
   - Highly dissatisfied
6. Do you find the usage of ATMs to be user-friendly?
   - Yes
   - No
7. Is your bank offering you some discounts/offers due to age?
   - Yes
   - No

Section 3 Rate your opinion.

Rate the below bank services on a scale from 1 to 5, where “1” stands for “Highly ineffective” whereas “5” stands for “Highly effective”:

1. Cash Deposit & Withdrawal
   - 1
   - 2

- 3
- 4
- 5

2. Balance check
   - 1
   - 2
   - 3
   - 4
   - 5
3. Money Transfer to Private individuals
   - 1
   - 2
   - 3
   - 4
   - 5
4. Password change
   - 1
   - 2
   - 3
   - 4
   - 5
5. Regular Bill Payment
   - 1
   - 2
   - 3
   - 4
   - 5
6. Managing bank cards
   - 1
   - 2
   - 3
   - 4
   - 5
7. Managing investment
   - 1
   - 2
   - 3
   - 4
   - 5
8. Managing loans
   - 1
   - 2
   - 3
   - 4
   - 5
9. Security of accounts
   - 1
   - 2
   - 3
   - 4
   - 5

10. Privacy options
    - 1
    - 2
    - 3
    - 4
    - 5
11. Proper training tutorials for beginners/ new customers
    - 1
    - 2
    - 3
    - 4
    - 5
12. Customer care service
    - 1
    - 2
    - 3
    - 4
    - 5
13. Newsletter/ information sharing platforms/ emails/ text messages/ medium of communication
    - 1
    - 2
    - 3
    - 4
    - 5

Section 4
Socio-demographic questions

Gender
- Male
- Female
- Others
- I do not wish to answer

Age
- 51-60 years
- 61-70 years
- 71-80 years
- over 80 years

Occupation
- Self-employed
- Retired
- Just employed
- Unemployed but job-seeker

What is your degree of qualification?

- High school or lower
- Bachelors
- Masters
- Ph.D.

Where do you come from?
- Europe
- Asia

- Africa
- South America
- North America

Thank you very much for your valuable time!

Section 5 di 6
Rate your opinion.
Rate the below bank services on a scale from 1 to 5, where “1” stands for “Highly ineffective” whereas “5” stands for “Highly effective”:

1. Cash Deposit & Withdrawal
   - 1
   - 2
   - 3
   - 4
   - 5
2. Balance check
   - 1
   - 2
   - 3
   - 4
   - 5
3. Money Transfer to Private individuals
   - 1
   - 2
   - 3
   - 4
   - 5
4. Password change
   - 1
   - 2
   - 3
   - 4
   - 5
5. Regular Bill Payment
   - 1
   - 2
   - 3
   - 4
   - 5
6. Managing bank cards
   - 1
   - 2
   - 3
   - 4
   - 5
7. Managing investment
   - 1
   - 2
   - 3
   - 4

- 5

8. Managing loans
   - 1
   - 2
   - 3
   - 4
   - 5
9. Security of accounts
   - 1
   - 2
   - 3
   - 4
   - 5
10. Privacy options
    - 1
    - 2
    - 3
    - 4
    - 5
11. Proper training tutorials for beginners/ new customers
    - 1
    - 2
    - 3
    - 4
    - 5
12. Customer care service
    - 1
    - 2
    - 3
    - 4
    - 5
13. Newsletter/ information sharing platforms/ emails/ text messages/ medium of communication
    - 1
    - 2
    - 3
    - 4
    - 5

Section 6
Socio-demographic questions

Gender
- Male
- Female
- Others

I do not wish to answer
Age
- 51-60 years
- 61-70 years
- 71-80 years
- over 80 years

Occupation

- Self-employed
- Retired
- Just employed
- Unemployed but job-seeker

What is your degree of qualification? *

- High school or lower
- Bachelors
- Masters
- Ph.D.

Where do you come from?

- Europe
- Asia
- Africa
- South America
- North America

Resume

Pealkiri: Hõbedane majandus pangandussektoris

See uuring uurib seost demograafiliste tegurite (vanus, amet, kvalifikatsioon, sugu ja riik) ja erinevate pangateenuste tõhususe mõõdupuu hõbeskoori vahel. Vaatlusandmeid kasutades kasutatakse mitmekordse regressiooni mudelit, et uurida nende muutujate mõju hõbeskoorile ning leitakse, et amet, kvalifikatsioon ning soo ja riigi vaheline interaktsioon ei mõjuta hõbeskoori oluliselt. Siiski leitakse, et vanus on oluline ennustaja ja polünoomne regressioonimudel, mis sisaldab vanust, vanust ruudus ja vanuse kuupis, näitab suurt seletusvõimet R-ruudu väärtusega 0,74. Need leiud viitavad sellele, et vanus on hõbedase skoori määramisel kriitiline, mis näitab, et vanematel klientidel võivad pangateenuste kasutamisel olla erinevad kogemused ja eelistused. Selle uuringu tulemused aitavad meil mõista tegureid, mis mõjutavad vanemate inimeste klientide rahulolu pangateenustega. Rõhutades vanuse kui ennustava muutuja tähtsust, saavad finantsasutused kohandada oma teenuseid nii, et need vastaksid paremini vanemate klientide vajadustele. Vaadatud kirjanduse põhjal täheldasime, et kuigi hõbemajanduse tähtsuse üle arutleti palju, puuduvad empiirilised uuringud selle kohta, millist mõju võib kliendi vanus selle hõbedamajanduse mõjuteguritele avaldada. Kirjandusest ja põhjaliku arutelu põhjal mitme pangandussektori silmapaistva inimesega (kellel on selles küsimuses praktilised teadmised) lõime uue konstruktsiooni nimega hõbeskoor, mis moodustatakse 16 muutuja kombineerimisel, nimelt ooteaeg, e-makse. , rakenduskogemus, sissemakse ja väljamakse, saldokontroll, rahaülekanne, paroolivahetus, arvete tasumine, mobiilikaardid, mobiiliinvesteering, mobiililaenud, turvalisus, privaatsusvalikud, õpetused, klienditeenindus ja uudiskiri. Kavandatav mudel on esitatud selleks, et mõista seost hõbedase skoori ja ennustavate muutujate (vanus, amet, kvalifikatsioon) ja näivate muutujate (sugu, riik) vahel. Sellega loodame uurida kliendi vanuse, tema ameti ja kvalifikatsiooni mõju sellele hõbedasele hindele, samas kui soo ja riik mõjuvad modereerivatele teguritele. Mudeli eesmärk on tabada nende muutujate keerukat koosmõju ja nende mõju vanemate täiskasvanute üldisele mobiilipanga kogemusele. Uurimisküsimus: kas kliendi vanus, amet ja hariduslik kvalifikatsioon mõjutavad tema panganduskogemuse kvaliteeti (mõõdetuna hõbeskooriga)?

meie uuring keskendus konkreetsele kliendikogemusega seotud muutujate komplektile ja on võimalik, et hõbeskoori võivad mõjutada ka teised mõõtmata muutujad. Meie analüüsi ei kaasatud selliseid tegureid nagu klientide ootused, eelnev kogemus sarnaste teenustega ega individuaalsed eelistused.

meie valim koosnes konkreetsest populatsioonist ja leidude üldistamisel muudesse kontekstidesse tuleks olla ettevaatlik. Uuring viidi läbi konkreetses tööstusharus või riigis ning kultuurilised ja kontekstuaalsed tegurid võivad vanuse ja klientide rahulolu vahelist seost teistes tingimustes erinevalt mõjutada.

enda esitatud andmete kasutamine võib põhjustada erapoolikust. Osalejate vastuseid võivad mõjutada sotsiaalse soovitavuse eelarvamused või mälu meeldejätmise probleemid, mis võivad mõjutada teatatud hõbeda skoori ja muude muutujate täpsust. uuringus kasutati ristlõike disaini, mis piiras meie võimet teha põhjuslikke järeldusi. Kuigi meie mudelil oli ristvalideerimisega hinnatud hea ennustustäpsus, võivad tulevased uuringud kinnitada tulemusi väliste andmekogumite abil või viia läbi tulevasi uuringuid, et veelgi kinnitada mudeli ennustamisvõimaluste tugevust ja üldistavust. Nendest piirangutest hoolimata annab meie uuring väärtuslikku teavet vanuse ja klientide rahulolu vahelise seose kohta. Täheldatud olulised mittelineaarsed mõjud rõhutavad vajadust kohandatud strateegiate järele, et rahuldada eri vanuserühmade kliente. Organisatsioonid saavad neid tulemusi kasutada eesmärgistatud lähenemisviiside väljatöötamiseks kliendikogemuse ja rahulolu suurendamiseks, mis põhinevad vanusega seotud eelistustel ja ootustel.

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