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LONGEVITY RISK MITIGATION AND ITS DETERMINANTS: AN EMPIRICAL STUDY OF THAI SOCIETY

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ABSTRACT

Globally, societies are aging, and within Thai society, the number of people aged from 54 to 70 years has also been increasing. Longevity is defined as living longer; however, increasing longevity raises the need for financial planning. The prime objective of this study was, therefore, to assess the longevity risk mitigation while the second aim was to examine the personality factors, socio-environmental factors, and organizational factors. This study applied descriptive statistics and an inferential model - multiple discriminant analysis - to assess the longevity risk mitigation and its determinants in Thai society, respectively. Risk management, financial behavior, and financial socialization theories were used to construct a theoretical framework. Data were gathered from an empirical survey given to an employable age range. The results suggested that Thai society is financially prepared for aging. From the multiple discriminant analysis, individual factors were found to be most significantly associated with longevity risk mitigation. With regard to policy recommendations, firstly, human beings should understand financial literacy, and it should be taught as a subject of compulsory education. Secondly, the authors found the association between the high maturity level of the longevity risk mitigation and family relationship. This inferred that family conversion in the aspects of conscious money could be possible to increase the awareness of longevity. In order to validate the data, future research should find secondary data to reconcile with the primary information of this current study.

Keywords: Aging society; longevity; longevity risk; discriminant analysis

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1. INTRODUCTION

Human's longevity is being extended by several factors, including a trend toward healthier lifestyles and advances in medical treatments. Thus, longevity has increased individual and household happiness, as it allows families to remain intact longer. However, increasing the life expectancy presents challenges at both the individual and policy levels. As a consequence, retirement planning could become a growing burden (Hershey et al., 2010). Additionally, Thailand's state social security would be unsustainable unless contributions to the pension fund were increased, as the reserves were predicted to be zero by 2052 (Saardchom, 2016).

Longevity risk is defined as "the risk that individuals live longer than anticipated" (Patrick et al., 2015; Roy, 2012), and accounts for "the economic consequences of outliving a portfolio of financial assets tasked with supplying lifetime income". Roy (2012) noted that global life expectancy surged dramatically from 47.7 years

in 1950-1955 to 67.9 years in 2005-2010. However, while overall life expectancy at birth is at unprecedentedly high levels, significant differences across regions persist (United Nations, 2017).

As shown in Figure 1, the longest life expectancy at birth is found in Northern America at 80 years. However, this accounts for only 5% of the world's population. Africa, which accounts for 16%, has the lowest life expectancy at birth of 61 years.

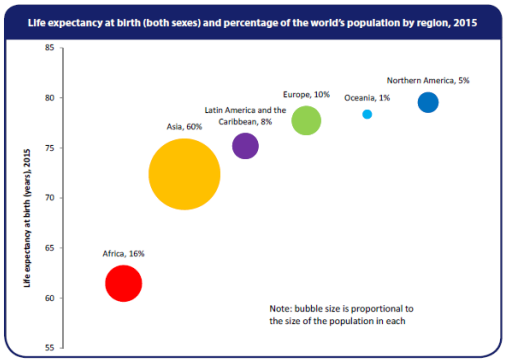


Figure 1: Life Expectancy Across Regions (United Nations, 2017)

While longevity is higher in developed countries, at 76.9 years (2005-2010), less developed countries have seen greater increases in life expectancy from 42.3 years in 1950-1955 to 66 years in 2005-2010 (Roy, 2012).

The proportion of seniors within Asian populations grew from 6% in 2000 to 8.3% in 2017, and is predicted to increase by a further 18% by 2050 (Asian Development Bank, 2018: Vii). The Asian Development Bank (ADB) has also forecast that three countries will experience the most significant rise in the proportion of seniors by 2050: The Republic of Korea, Singapore, and Thailand.

Prasartkul et al. (2019) reported that Thailand's birth rate had fallen below replacement causing the labor market to constantly shrink. Conversely, the rapid increase in the elderly population is creating a "demographic disruption". As shown in Figure 2, statistics from Thailand's National Statistics Office (NSO) show that although the majority of the Thai population is in the 25-49 years range, between 2009 and 2018, the greatest increase in the population share was among those aged 50 years or older. Therefore, Thailand is faced with a rapidly aging society.

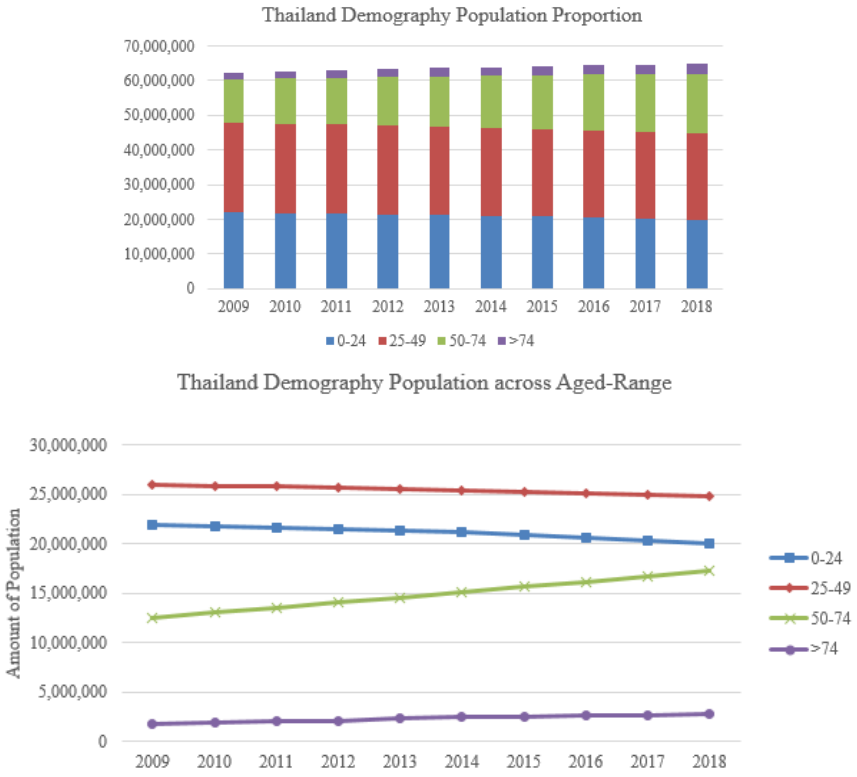


Figure 2: Thai Demography by Age Group and Over Time (Thailand National Statistics Office, 2020)

Hence, an aging society challenges the ability of individuals and households to set aside sufficient funds to cover a lengthy period of retirement. Private organizations must also deposit enough money in provident funds to cover staff retirement costs. Moreover, government and other policymakers must propose adequate pension funds or social security schemes. Additionally, studies have shown that rural Thai households overspend their income, and therefore have negative savings (Patmasiriwat and Hengpatana, 2016; Suppakitjarak and Krishnamra, 2015). At the time this paper was written, the world was facing a global crisis from the Coronavirus 2019 pandemic (COVID-19) (World Health Organization, 2020). This has added the threat of substantial job losses to the risk posed by increasing longevity.

In addition, insurers are creating sophisticated financial products to mitigate the risk associated with extended longevity. However, this paper was concerned with the demand-side analysis. The focus was therefore on primary data concerning middle-aged citizens working in public, private, and state enterprise organizations. The first goal was to assess the longevity risk mitigation in Thai society. As such, the authors examined the personality factors, socio-environmental factors, and organizational factors using quantitative models.

The expected contributions were to help policymakers understand the longevity risk and its determinants, and to examine the role of pension funds, social security systems, and national policies in encouraging saving. Insurance companies and financial institutions could view longevity risk mitigation as a way of improving the competitiveness of their product portfolios. Finally, the study intended to promote awareness of the longevity risk at the level of individuals and households.

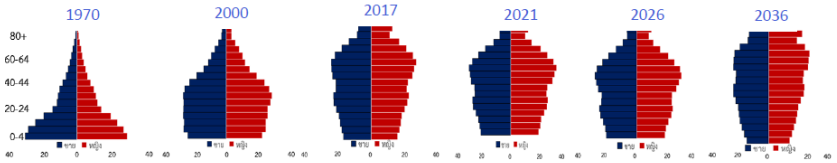
2. SIGNS OF AN AGING SOCIETY IN THAILAND

Thailand was initially formed in the thirteenth century, and was known as Siam until 1939. Thailand lies at the centre of Southeast Asia and shares borders with Myanmar, Lao PDR., Cambodia, and Malaysia (Prasartkul et al., 2019).

As Figure 3 shows Thailand has a rapidly aging population. In 2021, Thailand's elderly will comprise 20% of the total population, and has been forecast by the Office of the National Economic and Social Development Council (NESDC) to grow to 30% by 2036. If the population is divided into young-old (60-69 years), middle-old (70-79 years), and oldest-old (80 years above), the young-old component is expected to decline over the next 20 years.

In 1982, Thailand's National Elderly Council was established to assess the impact of the growth in the number of the elderly (Jitapunkul and Wivatvanit, 2009: 63). A National Committee for Senior Citizens was established, and a national plan formulated. This discussed the promotion of a positive mindset toward elderly persons, health support for the elderly, and social protection.

Situation of Aging Society in Thailand



Pop.	1970	2000	2017	2026	2036
Total	34.4 mil.	60.9 mil.	65.5 mil.	66.4 mil.	65.1 mil.
60 yrs +	1.7 mil. (4.9%)	5.8 mil. (9.5%)	11.2 mil. (17.1%)	15.6 mil. (23.4%)	19.7 mil. (30.2%)
15-59 yrs	17.2 mil. (50.0%)	40.3 mil.(66.1%)	42.8 mil. (65.3%)	40.4 mil. (60.8%)	36.6 mil. (56.2%)
0-14 yrs	15.5 mil. (45.1%)	14.8 mil.(24.4%)	11.5 mil. (17.6%)	10.4 mil. (15.6%)	8.8 mil. (13.6%)

Figure 3: Changing Age Structure of Thailand's Population (Rojananan, 2018)

To realize this national plan, there is a need to focus on the financial implications. Moreover, Thailand's children are currently below, while the elderly population is increasing (Figure 4) (United Nations Population Fund, 2015: 21). The low birth rate means that the future population would be unable to rely on these income sources.

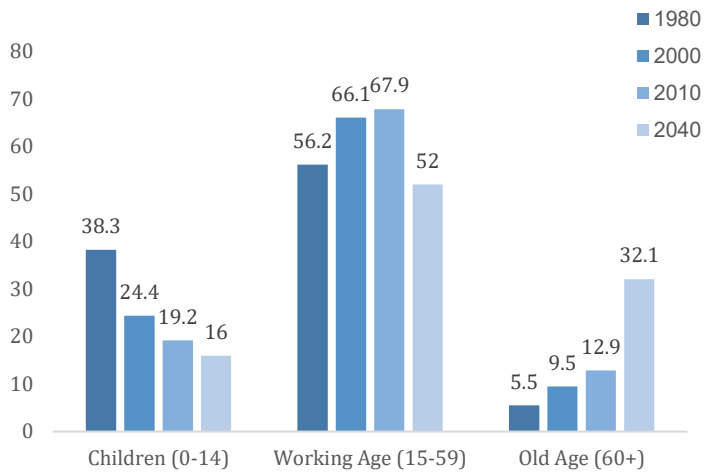


Figure 4: Trend in Thailand's Fertility (United Nations Population Fund, 2015, p. 21)

A survey of the elderly population by the NSO showed that many people had no savings. Active elderly persons also found it difficult to secure employment. Thus, the Thai government created the Second National Plan on the Elderly (NPE) (2002-2021) to address aging problems through five strategies: 1) preparation by the people for their quality of life in later years, 2) promotion and development of the elderly, 3) social safeguards, 4) development and management of a comprehensive national system, and 5) the production, upgrading, and dissemination of knowledge about the elderly. However, satisfactory outcomes have not yet been achieved. A national policy should include strategies for the mitigation of the longevity risk, which the NPE does not currently consider.

3. CONSTRUCT THEORY FOR LONGEVITY MODELS

3.1 Definition of the longevity risk

Risk is multifaceted, but most theories interpret risk as negative or undesirable events. However, modern studies have compared risks with opportunities. Benjamin (2017) and Sae-Lim (2018; 2019) found significant correlations between these two aspects. To illustrate, in investment decisions, multiple risks are compromised against the expectations of inflation.

Historically, the study of risks was more concerned with the quantification of losses. Mathematically, risk is treated as a deviation from a goal. Many mathematical models are also designed to measure the losses associated with particular risks. Rosa (1998) defined risk in a way that varies with context. Spikin (2013) defined risk as expected loss, adverse outcome. Many types of risk are also recognized. At the level of an enterprise, risks are divided into strategic, operational, financial, and compliance (Committee of Sponsoring Organizations of the Treadway Commission, 2017). Additionally, the World Economic Forum (2019) divided global risk types into environmental, societal, geopolitical, and technological.

Nevertheless, longevity risk falls into the category of "personal risk". The Society of Actuaries (SOA) defined personal risk in terms of an individual loss associated with financial investment or insurance. Longevity risk is itself associated with the prolongation of life. Roy (2012) and the Asian Development Bank (2018) defined longevity risk as the risk that the actual lifespans of individuals, or of whole populations, would exceed the expected lifespan. Most studies are concerned with the supply-side by focusing on mitigation, whereas the demand-side has been largely neglected. In a developing country like Thailand, and especially in rural areas, many households spend more than their income, so the rate of saving is negative (Patmasiriwat and Hengpatana, 2016). To assess preparedness, a longevity scale would be proposed.

3.2 Operationalization of the longevity risk mitigation

Risk management is not a project but rather a program. To be more precise, risk management must change within a business model, rather than focus on the end point, as in a project. When firms try to embed risk, risk management standards are put in place. The Committee of Sponsoring Organizations of the Treadway Commission, Enterprise Risk Management (COSO ERM) and ISO 31000 are two well-known standards. They make it clear that risk management should start from the creation of a suitable environment and an adequate leadership model. Hence, risk is identified from internal and external factors and analyzed using quantitative and qualitative risk assessment. Risk mitigation strategies and monitoring are then embedded in the risk

management process. If the focus is on longevity risk mitigation, four strategies would be appropriate for this purpose: 1. longevity risk reduction, 2. longevity risk transfer, 3. longevity risk avoidance, and 4. longevity risk acceptance (Committee of Sponsoring Organizations of the Treadway Commission, 2017; Sae-Lim, 2018; 2019).

3.3 Related studies and theories on longevity risk mitigation determinants

Several factors influence longevity risk mitigation. Most previous studies have reported a strong correlation between longevity risk mitigation and individual financial behavior (Arifin, 2017; Olsen, 1998). For example, employment requiring education would significantly improve mitigating longevity risk than manual employment.

However, other factors may play a role. Payne et al. (2014) showed that associations exist between the family and individual factors. Their research supported the family financial socialization theory. Using this theory, Clinton and Sharon (2011) proposed that family interactions and relationships would be significantly associated with financial attitudes and behaviour. The influence family may have on financial capabilities and financial behavior must also be understood.

Other studies examined the social, economic, and psychological factors that would influence financial planning and therefore longevity risk mitigation (Hershey et al., 2010). These several determinants of longevity risk mitigation were used in the theoretical framework set out below.

3.4 Theoretical framework

As well as the factors introduced in the previous section, the authors believed that employment factors should also be taken into account. Employee benefits are one of the more appropriate tools in longevity risk mitigation. The theoretical framework is shown in Figure 5.

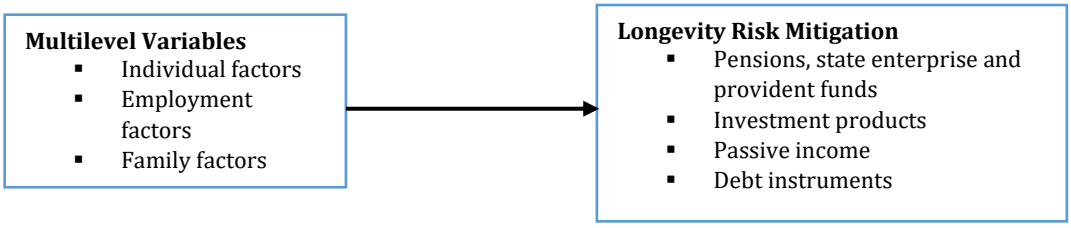


Figure 5: Theoretical Framework

4. METHODOLOGY

The model of this study was mainly quantitative though descriptive statistics were also developed. The analysis was conducted in two parts: the scale of longevity risk mitigation and causality analysis. Given the limitations on the secondary data, the former was developed using primary data. A four-point Likert scale was used to rank longevity risk mitigation from low to high. In the second part, discriminant analysis was used to identify the determinants from the theoretical framework.

4.1 Data and scale development

Primary data were collected from private, public, and state enterprise organizations. Data were collected from respondents of different ages, as the focus of the study was preparation.

There were three kinds of independent variables. The individual factors included the demographic variables and financial knowledge and behavior. Employment factors included organizational type, positions held, welfare coverage, and the working environment. Financial knowledge and family relationships were also both considered to be family factors. The dependent variables were the measures of risk mitigation. These are shown in Table 1.

Table 1: Longevity Risk Mitigation

Scale	Score	Definitions
1	Below 11	Very low level of mitigation.
2	11-14	Low level of mitigation.
3	15-19	Already joined or planning to join a pension fund, state enterprise fund, provident fund, retirement mutual fund, or to purchase financial products: fixed income, equities, passive income, or insurance products.
4	20-24	Already have purchased or planning to purchase financial products: fixed income, equities, passive income, or insurance products for more than three years.

4.2 Empirical modeling

The descriptive statistics of central tendency, data distribution, and dispersion were first used to characterize the sample (Vogt, 2007).

Analysis of variance (ANOVA) was used to identify significant differences among the independent variables. Multiple discriminant analysis (MDA) is a technique that is used when the dependent variables are known a priori, as well as a category-nonmetric (Hair et al., 2010; Härdle and Simar, 2015). MDA was applied to the longevity mitigations in Table 1, which were in the range of 1-4. Normal multiple regression modeling was limited to cases where the dependent variable on the Y axis was an interval variable.

The banking sector usually applies logistic regression (LR) to divide customers into two groups: good credit vs bad. However, in this study, the authors posited more than two categories. Furthermore, Alayande and Adekunle (2015) noted that MDA was more powerful than LR due to the restricted assumptions used. Data that would fit an MDA model would need to meet the following conditions: (1) independent variables have a multivariate normal distribution, (2) a low level of multicollinearity, (3) homoscedasticity, and (4) linearity. In this paper, the data also tested the statistical assumption shown in Table 6. Hair et al. (2010:17) stated that "in many instances, particularly with more than two levels of the dependent variable, discriminant analysis is the more appropriate".

If $Y_i = Multiple\ Discriminant\ Function: i = 1 - 4$ the predictive model in this study is $\gamma_{i=}$ the discriminant coefficient or weight for that variable.

$$Y_i = = a + \gamma_1 X_1 + \gamma_2 X_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + \gamma_{14} X_{14}$$

Table 2: Independent Variables

Individual Factors	Employment Factors	Family Factors
Sex	Organizational Type	Relationship Level
Age Range	Position Level	Family Financial Knowledge Level
Status	Welfare Coverage	Close Friend/Partner Financial Knowledge Level
Education Level	Workplace Environment	
Salary Range		
Financial Knowledge Level		
Preparation Level		

5. RESULTS

5.1 Characteristics of the respondents

Of the 395 respondents, 65% were female. Table 3 shows that over 50% were aged between 25 and 36 years, while 93.4% were in employment that required a bachelor's degree or higher.

Table 4 shows the longevity risk mitigation rating of the respondents. Approximately 59% who were already contributing to a pension fund, state enterprise fund, provident fund, or retirement mutual fund were also purchasing fixed income, equity securities, creating passive income vehicles, or insurance products, or were planning to do so. Only 18% were categorized as having a low level of longevity risk mitigation.

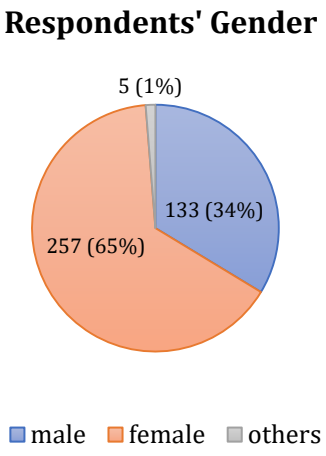


Figure 6: Respondents' Gender

Table 3: Age Range and Education Level

	Amount	%
Age Range		
25-30	126	31.9
31-36	118	29.9
37-42	60	15.2
43-48	26	6.6
49-54	24	6.1
>54	41	10.4
Total	395	100
Education Level		
Vocational	8	2.0
Below Bachelor	18	4.6
Bachelor's Degree	198	50.1
Master's Degree	151	38.2
Doctoral Degree	20	5.1
Total	395	100

Table 4: Longevity Risk Mitigation

Longevity Risk Mitigation Scale	Amount	%
2	72	18.2
3	233	59.0
4	90	22.8
Total	395	100.0

5.2 Comparison of the mean

ANOVA was used to compare the contribution of each factor to the level of longevity risk mitigation.

Table 5: ANOVA Result

Factors	F Statistics	P-value
Individual Factors		
Sex	5.656	.004
Age Range	7.288	.001
Status	2.867	.058
Education Level	15.521	.000
Salary Range	35.403	.000
Financial Knowledge Level	40.511	.000
Preparation Level	36.601	.000
Employment Factors		
Organizational Type	.251	.778
Position Level	6.992	.001
Welfare Coverage	12.117	.000
Workplace Environment	10.872	.000
Family Factors		
Relationship	13.145	.000
Family Financial Knowledge	7.274	.001
Close friend/Partner Financial Knowledge Level	2.033	.132

Most of the factors in Table 5 were significant at a 95% confidence interval (p-value < 0.05). The insignificant factors were status (individual factor), organization type (employment factor), and financial knowledge of close friend/partner (family factor).

5.3 Influential factors

Before applying the DA model, the authors checked for violations of assumptions. The sample size of 395 was five times the number of independent variables (Hair et al., 2010). None of the 14 independent sub-variables exhibited multicollinearity. The VIF was between 1 and 2, which was within the acceptable limit of VIF>10. Most importantly, skewness and kurtosis were mainly in the range -2 to 2, or within the acceptable limits for normality testing (Trochim and Donnelly, 2006). This confirmed a symmetrical as well as normal distribution.

Table 6: Assumption Testing

Factors	VIF	Skewness and Kurtosis
Individual Factors		
Sex	1.047	(-0.44, -1.05)
Age Range	1.507	(1.04,0.04)
Status	1.327	(0.97, -0.24)
Education Level	1.242	(-0.35,1.08)
Salary Range	1.156	(1.59,2.46)

Table 6: Assumption Testing (continued)

Factors	VIF	Skewness and Kurtosis
Individual Factors		
Financial Knowledge Level	1.811	(-0.17, -0.57)
Preparation Level	1.744	(-0.21.-0.11)
Employment Factors		
Organizational Types	1.352	(1.49,0.73)
Position Level	1.383	(0.60, -1.24)
Welfare Coverage	1.732	(-0.72, -0.57)
Workplace Environment	1.706	(-0.03, -0.94)
Family Factors		
Relationship Level	1.306	(-1.11, 0.91)
Family Financial Knowledge Level	1.548	(-0.25, -0.34)
Close friend/Partner Financial Knowledge Level	1.467	(-0.37, -0.26)

For three variables and 14 sub-variables, stepwise analysis using the Mahalanobis distance method could be used in the MDA. This sequentially adds or deletes variables, and is more dynamic than the entering method. As the nonmetric dependent variables had three levels (none had an observed value of 1), discriminant analysis was able to estimate two discriminant functions. As shown in Table 7, overall, the independent sub-variables were able to predict the discriminant score (Sig = 0). For the model of fit, 56% of the grouped cases were correctly classified (Table 8).

The conceptual framework shown in Figure 5 was derived from the theoretical framework. Within the empirical data, not all independent sub-variables were statistically significant. Within the individual factors (Table 9), only salary range, financial knowledge level, and preparation level were found to predict longevity risk mitigation. Within the employment factors, position was associated with longevity risk mitigation. Within the family factors, better relationships were associated with stronger longevity risk mitigation.

Table 7: MDA Overall Performance

MDA Functions	Wilks' lambda (Sig)	Canonical Correlation
1	0.000	0.535
2	0.000	0.236

Table 8: Classification Results

		Predicted Group Member			Total
		2	3	4	
Count	2	48	23	1	72
	3	62	112	59	233
	4	12	17	61	90
%	2	66.7	31.9	1.4	100
	3	26.6	48.1	25.3	100
	4	13.3	18.9	67.8	100

Fifty-six percent of the original grouped cases were correctly classified.

Table 9: Variables in and not in the analysis

Variables in the Analysis	Variables not in the Analysis
Individual Factors	*Individual Factors*
Salary Range	Sex
Financial Knowledge Level	Age Range
Preparation Level	Status
	Education Level
Employment Factors	*Employment Factors*
Position Level	Organizational Types
	Welfare Coverage
	Workplace Environment
Family Factors	*Family Factors*
Relationship Level	Family Financial Knowledge Level
	Close friend/ Partner Financial Knowledge Level

The two MDA models are shown below.

Longevity risk mitigation level model 1

= -4.773+0.428 salary range; +0.404 financial knowledge level; +0.499 prepared level; +0.04 position; +0.131 relationship level.

Longevity risk mitigation level model 2

= -3.344+-0.055 salary range; +0.173 financial knowledge level; +-0.382 prepare level; +-0.147 position; + 1.082 relationship level.

6. CONCLUSIONS

This study assessed the demand-side awareness of and preparation for longevity risk. Quantitative modeling suggested that the most highly educated section of Thai society had started to prepare for their elderly years. Among the respondents of this current study, 82% were well prepared financially for aging having already set aside salary in provident, state enterprise, or other pension funds. Some respondents had already invested in low- or high-risk financial products: fixed income, mutual equity funds, or savings.

They were also interested in establishing a passive income, adjusting debt, or increasing saving. Individual, employment, and family factors were divided into 14 independent variables. All data were able to fit well with the assumptions of a statistical inferential model. The sample size was sufficiently large, and the data matched a symmetrical normal distribution with little multicollinearity.

ANOVA indicated that 11 of the independent variables were significantly correlated with longevity risk mitigation. These included educational level, salary, and welfare coverage. The empirical data confirmed the theoretical models. The determinant factors of longevity risk also supported the given risk management, family financial socialization, financial behavior theories, but not all the variables (Arifin, 2017; Clinton and Sharon, 2011: 648; Olsen, 1998). The MDA identified three key independent variables: salary range, financial knowledge level, and preparation level. The outstanding results displayed that within the employment factors, "position" was significant, and within the family factors, "relationship" was significant. The analysis suggested that longevity risk awareness depended mainly on individual factors.

7. DISCUSSION AND POLICY RECOMMENDATIONS

This study confirmed family financial socialization and financial behavior theories; nonetheless, from the theoretical contribution in this study, the authors found the association between longevity risk mitigation and employment factors. That is, the workplace was also related to how people mitigated longevity risk.

As a result of the global pandemic crises at the beginning of 2020, the Coronavirus Disease 2019 (COVID-19) caused by a newly discovered coronavirus (World Health Organization, 2020), this has caused human losses similar to the severe acute respiratory syndrome (SARS). According to WHO (as of September 2020), the number of confirmed cases globally accounted for 27,236,916 with 891,031 deaths. Even though Thai society has been able to successfully cope with COVID-19 compared to other countries, an economic recession has obviously had an effect in the second quarter in 2020, where the gross domestic product (GDP) in Thailand dropped to 12.2% compared to the first quarter (National Economic and Social Development Board, 2020). Because of this concern, longevity risk mitigations should be initiated and implemented.

Longevity risk operates at both the household and societal levels. In order to mitigate longevity, several stakeholders should include the process of policy recommendations. Thus, the authors have proposed three levels of policy recommendations as follows:

National level:

This study found an association between financial knowledge and longevity risk mitigation. People who had more financial knowledge would be better prepared for their elderly years. Thus, the Ministry of Education should implement financial literacy as a compulsory subject. Moreover, the issue of taxation and social security, which are operated under the government should be reconsidered. For the former, systematic taxation in developed countries; such as, those in Scandinavia are relative to aging social welfare. For the latter, to have sufficient reserve funds for old age, social security should be restructured.

Workplace level:

Though welfare coverage was statistically insignificant, the authors found the association between salary, position, and longevity risk mitigation. An employee who has a higher position would better mitigate longevity. From this result, it could be interpreted that he/she would either have more risk awareness or more reserve money due to having a higher salary. To rectify this issue, the workplace should also increase workplace welfare coverage as well as propose alternative welfare.

Family and individual level:

Financial knowledge individually accumulates while family members can assist each other to mitigate the longevity risk. The authors found a significant association between family relationships and longevity risk mitigation. Closer relationships may encourage financial discussion and mutual activities, which may build longevity awareness. The issues of finance should be raised as a family topic.

In this study, the authors attempted to build awareness of the longevity risk at an initial phase. Future studies should rectify this research's shortcomings. First of all, future researchers should find dependent variables that could support the secondary data and reconcile with the survey's empirical base. Moreover, one important limitation in this study was about the type of respondents. To be precise, more than 50% of them

had knowledgeable employment. This inferred that they had started to financially prepare for the elderly years. Furthermore, the diversification of the population types should be included into future research projects, and future respondents should be located in both local and downtown areas.

All in all, most of the people interpreted longevity only in terms of money and financial planning. Nevertheless, there were also human aspects to longevity (Rappaport, 2018: 44); such as, social engagement, psychological effects, and postretirement risks in which future research should be formulated.

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