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Household Financial Behaviour and Systemic Blind Spots: A Multidimensional Framework for Early Warning Indicators

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Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Abstract

This paper develops a behavioural framework to analyse how household financial vulnerabilities transform into systemic risks. Using structural equation modelling on Ireland's 2020 Survey on Income and Living Conditions, we identify five behavioural dimensions as early warning indicators for financial stability: Financial Behaviours, Financial Satisfaction, Financial Difficulty, Minimum Income, and Financial Technology. Our decomposition analysis reveals financial vulnerability distribution consists of 37.2% between demographic groups and 62.8% within groups, creating distinct transmission channels for financial instability. Young adults display present-focused decision patterns that amplify economic shocks, while financial technology disparities introduce fragmentation risk as population segments interact with the financial system through opposing channels. Education attainment serves as a behavioural buffer against financial vulnerability, while the "squeezed middle" creates potential systemic vulnerability clusters. Financial stability authorities can implement our framework by integrating behavioural indicators into monitoring dashboards, establishing vulnerability thresholds for demographic segments, and developing graduated policy responses. The framework offers practical guidance for integrating technology-enabled monitoring with traditional macroprudential tools, balancing implementation costs with blind spot detection across diverse statistical capabilities and regulatory contexts. These empirically validated indicators complement traditional macroprudential tools, by identifying stability blind spots, and thus financial stability monitoring across diverse economic conditions.

Keywords: Financial Stability, Systemic Risk, Behavioural Economics, Structural Equation Modelling, Financial Technology, Macroprudential Policy

JEL Code: D31, G51, D91, I32, D14, G28

1. Introduction

Financial well-being (FWB) represents a complex multidimensional construct that shapes economic decision-making across population segments. While traditional welfare economics focuses on income and wealth metrics (Jenkins, 2020; Cowell and Van Kerm, 2016), these one-dimensional approaches fail to capture behavioural responses to financial circumstances or how these behaviours collectively create systemic vulnerabilities.

The 2008 global financial crisis provided stark evidence of how household financial vulnerabilities transform into systemic risks. While systemic failures in subprime lending and securitization created initial default risk, US mortgage defaults concentrated among specific demographic segments rapidly cascaded into a worldwide financial meltdown. Central banks estimated that household debt service ratios increased by 4.1 percentage points in affected countries, creating correlated default patterns that overwhelmed traditional risk models (Bank for International Settlements, 2021). Traditional financial stability metrics focusing on institutional leverage ratios and liquidity measures failed to capture these emerging household-level risks (Ampudia et al., 2016; Brunnermeier et al., 2021).

Our framework explicitly indicates transmission channels through which household behaviour creates systemic risk by (1) identifying demographic clustering of correlated financial vulnerabilities, (2) documenting technological facilitation of credit expansion outside traditional monitoring systems, (3) analysing behavioural contagion through reference group effects, (4) exposing institutional barriers creating blind spots in regulatory oversight, and (5) measuring heterogeneous responses to identical economic shocks.

Our investigation makes three specific contributions to financial stability monitoring. First, we develop a measurement framework that differentiates behavioural, cognitive, and technological components and identifies their interdependencies through structural equation modelling. Unlike previous research that treated these components separately (Netemeyer et al., 2018; Brüggén et al., 2017), our framework empirically validates their interconnections and systemic implications. Second, we ensure the validity of cross-group comparisons by examining systematic demographic differences in financial behaviour, allowing us to identify clusters of vulnerability that may be caused by systemic failures and subsequently create systemic consequences. Third, we apply a decomposition approach grounded in theory to measure inequality within and between groups, quantifying how financial disparities are distributed across demographic segments and highlighting specific behavioural patterns that contribute to

systemic risk. Beyond these methodological contributions, we provide evidence of the breadth of the "squeezed middle" with lower to middle income households under financial strain, creating potential system-wide vulnerability that may not be captured by traditional financial stability metrics.

Using Ireland's 2020 Survey on Income and Living Conditions, we identify five behavioural dimensions that interact to shape financial well-being and systemic resilience: Financial Behaviours, Financial Satisfaction, Financial Difficulty, Minimum Income, and Financial Technology. Each dimension creates specific channels for systemic risk transmission: Financial Behaviours reflects precautionary buffers against economic shocks; Financial Satisfaction serves as an early warning indicator of changing behaviours; Financial Difficulty identifies constraint management behaviours during stress; Minimum Income reveals consumption response thresholds; and Financial Technology exposes new channels for financial risk by creating technological fragmentation in how different population segments interact with the financial system.

Our research addresses five key questions relevant to financial stability:

1. How do behavioural dimensions of household financial management create correlated vulnerability patterns that could amplify into systemic risks during periods of economic stress?
2. How does demographic clustering of financial behaviours create potential contagion/spillover channels through which individual shocks can transform into system-wide instability?
3. How do institutional structures create and reinforce demographic concentration of financial vulnerabilities that may escape traditional macroprudential monitoring frameworks?
4. What decomposition approaches can quantify the systemic relevance of behavioural patterns by distinguishing between demographic clustering (between-group) and individual variation (within-group) components of financial vulnerability?
5. Through which specific systemic risk transmission mechanisms do constraints in education, location, immigration status, income, and technology access create correlated default patterns and coordinated consumption reductions with system-wide implications?

Our findings demonstrate that financial well-being inequalities manifest through systematic behavioural differences in patterns, cognitive evaluations, and technological interactions. These insights enhance our understanding of economic behaviour and its stability implications (Stiglitz et al., 2009; OECD, 2020; Carton et al., 2022). By identifying behavioural vulnerabilities across demographic groups, our research provides new monitoring tools that help financial stability authorities identify risks before they escalate into systemic concerns.

2. Literature Review

2.1 Behavioural Dimensions of Financial Well-being and Stability Implications

Literature increasingly views financial well-being (FWB) as a multidimensional behavioural construct with systemic stability implications. Brüggen et al. (2017) define FWB as the perception of sustainable living standards and financial freedom, emphasising cognitive evaluations and behavioural responses that, when aggregated, can create systemic vulnerability patterns.

The "co-holding puzzle" represents an important stability-relevant phenomenon where households simultaneously maintain high-interest debt and low-yield liquid assets. Gross and Souleles (2002) documented this seemingly irrational behaviour, while Gathergood and Weber (2014) attributed it to mental accounting and present bias. Fulford (2015) proposed that some co-holding represents rational precautionary behaviour. These complex adaptation patterns create unexpected transmission mechanisms for financial shocks that do not follow standard economic assumptions about household balance sheet management. For example, in 2006, one out of three US families reported using credit cards for necessities such as rent, mortgage, car repairs, basic medical expenses, house repairs, shopping, utilities, or insurance (Garcia and Draut, 2009), creating systemic vulnerabilities that traditional models failed to capture.

The critical link between these behavioural phenomena and systemic risk emerges through correlation. When individual-level behaviours become correlated across demographic segments, systemic risks develop. Mian and Sufi (2018) demonstrated how household leverage cycles amplify macroeconomic shocks through coordinated deleveraging, creating system-wide instability through behavioural transmission mechanisms. While deleveraging might appear rational at the individual household level to shed expensive debt, the aggregated effect creates systemic instability through correlated financial responses.

These behavioural mechanisms complement traditional macroprudential frameworks focused on institutional vulnerabilities. Aikman et al. (2019) demonstrate how incorporating household behaviour into stability models significantly improves predictive capacity for systemic crises, showing behavioural indicators outperform standard credit-to-GDP measures in early warning systems. This integration addresses limitations in conventional stability metrics that focus primarily on banking sector balance sheets. Our research examines how these behavioural dimensions of household financial management create correlated vulnerability patterns that could amplify into systemic risks during periods of economic stress. It is worth noting that financial institutions may inadvertently encourage co-holding through product design and marketing strategies, creating a systemic market failure that traditional stability indicators overlook.

2.2 Demographic Patterns in Financial Decision-Making and Stability

Demographic differences in financial behaviour create distinct vulnerability clusters with systemic implications. Lusardi et al. (2017) found that 30-40% of retirement wealth inequality stems from financial knowledge differences, creating correlated vulnerability during economic downturns. When behavioural patterns concentrate within specific demographic segments, they create potential spillover channels that amplify economic shocks through coordinated responses (Ampudia et al., 2016; Brunnermeier et al., 2021).

Age-related behavioural differences show distinct financial vulnerability channels. Shim et al. (2009) identified distinctive patterns among young adults (18-24), including limited planning horizons and greater consumption orientation, which align with present bias (O'Donoghue & Rabin, 1999). In contrast, Atalay and Barrett (2022) showed how older adults maintain pre-retirement consumption levels despite income changes, demonstrating greater financial resilience during economic stress.

Gender differences reveal additional stability transmission mechanisms. Bucher-Koenen et al. (2017) found women demonstrating more conservative financial management strategies and lower financial technology adoption, creating gender-specific vulnerability pathways through which financial shocks can propagate asymmetrically. Immigration status influences financial behaviour through stability-relevant mechanisms. Painter (2013) documented how immigrants demonstrate distinct financial behaviours stemming from information asymmetries, reflecting ambiguity aversion (Ellsberg, 1961) rather than simple risk aversion. Servon (2017) further demonstrates how these barriers lead vulnerable populations to engage with alternative

financial service providers outside traditional banking systems. These adaptations create potential blind spots in financial stability monitoring.

Our study explores how demographic clustering of financial behaviours creates potential spillover channels through which idiosyncratic shocks can transform into system-wide instability.

2.3 Institutional Influences on Financial Behaviour and Stability

Institutional structures shape financial behaviour by creating choice architectures (Leonard et al., 2008) with implications for systemic risk transmission. The Social Determinants Framework (WHO, 2010) explains how socioeconomic context influences individual financial behaviour. Artazcoz et al. (2021) demonstrated how labour market policies influence financial behaviours across European welfare states.

Educational systems represent a critical institutional influence on financial behaviour. Lusardi and Mitchell's (2014) research demonstrates how educational systems shape financial literacy acquisition, influencing financial resilience during economic stress. Van der Crujisen et al. (2023) further show how education levels significantly impact trust in financial institutions, creating differential engagement patterns with systemic implications during periods of economic uncertainty. Systematic differences in financial education create uneven vulnerability distributions.

Technological infrastructure shapes financial behaviour through default options, choice framing, and attention manipulation. Johnson et al. (2012) demonstrated how minor presentation changes significantly influence financial decisions through attentional capture and cognitive ease. For example, online loan calculators help customers to make 'ability to repay' decisions, the presentational features of which are significant for decision making (Timmons et al., 2019; Timmons et al., 2022). These technological influenced choice architectures create new transmission channels for financial risk. Recent macroprudential literature highlights how technological fragmentation creates monitoring challenges. Claessens et al. (2021) document how differing technological adoption rates across demographic segments create 'blind spots' in traditional financial stability dashboards. Their analysis of European Central Bank data shows that traditional metrics capture only 62% of household financial vulnerabilities when technological engagement varies significantly across population segments.

Our investigation analyses how these institutional structures create and reinforce demographic concentration of financial vulnerabilities that may escape traditional macroprudential monitoring frameworks.

2.4 Decomposition Approaches for Financial Inequality and Stability

Methodological advances in inequality measurement provide tools for understanding behavioural mechanisms with stability implications. Following Jenkins (2020), our decomposition approach uses an axiomatic framework that allows separation of between-group and within-group inequality components, each reflecting distinct behavioural processes with specific stability implications.

Our approach divides total inequality in financial well-being into two components: differences between demographic groups and differences within these groups. This separation helps identify whether financial vulnerability clustering stems primarily from group membership or individual variations, with important implications for financial stability monitoring. Our inequality measure $I(X)$ satisfies fundamental axioms aligned with four behavioural economic principles relevant to stability monitoring. Following Cowell and Flachaire (2020), these support our decomposition: $I(X) = B(X) + W(X)$. $B(X)$ represents between-group components reflecting systematic variations in institutional constraints, while $W(X)$ represents within-group components capturing individual-level variations in risk preferences.

Experiments manipulating group membership salience (Chen & Li, 2009) demonstrate how this decomposition reflects psychological processes. When group identity becomes prominent, individuals shift toward group-normed behaviours. Field experiments on peer effects (Bursztyrn et al., 2014) show how social learning mechanisms create within-group homogeneity.

Our research develops decomposition approaches to quantify the systemic relevance of behavioural patterns by distinguishing between demographic clustering and individual variation components of financial vulnerability.

2.5 Behavioural Adaptations to Structural Constraints and Financial Stability Implications

Technological constraints shape financial behaviour through both access limitations and cognitive barriers with significant implications for financial stability. Beyond simple digital divides, research demonstrates these constraints create system-wide vulnerability through three distinct mechanisms.

First, digital skills and autonomy of use create different adoption patterns across demographic groups (DiMaggio and Hargittai, 2001), forming vulnerability pockets that can transform into systemic risks during economic downturns. Second, interface complexity increases cognitive load, particularly for older adults and those with limited technological experience (Parasuraman & Wilson, 2008), reducing computational resources available for financial decisions. As interfaces become more complex, these cognitive barriers further segment population groups, creating divergent transmission channels for financial shocks.

Third, emerging technologies can exploit behavioural vulnerabilities through rapid credit expansion. Buy-now-pay-later services reduce transaction friction through real-time credit automation, obscuring the distinction between spending and borrowing. This creates "shadow consumer credit" that may not appear in conventional monitoring systems until financial stress emerges (DeHaan et al., 2024). These technological fragmentation effects represent a significant departure from conventional macroprudential assumptions. Adrian and Liang (2018) argue that existing financial stability frameworks inadequately capture demographic disparities in technological engagement. Their analysis shows how different segments interact with financial systems through increasingly divergent channels, challenging core assumptions in traditional monitoring approaches. Financial stability metrics traditionally focus on aggregate exposure measures that may obscure concentrated vulnerabilities in specific demographic segments.

Our study identifies the specific transmission mechanisms through which constraints in education, location, immigration status, income, and technology access create correlated default patterns and synchronized consumption reductions with system-wide implications. Through this integrated literature review, we develop a comprehensive framework for understanding how household financial behaviour creates systemic risk through distinct but interconnected channels. This framework guides our empirical analysis of Irish SILC data to identify early warning indicators for financial stability authorities.

3. Methodology

To examine behavioural dimensions of financial well-being and their systemic risk implications, we employed structural equation modelling on data from Ireland's 2020 Survey on Income and Living Conditions (SILC).

3.1 Data and Framework

The Irish SILC provides comprehensive information on economic behaviour across 11,128 households. This dataset is particularly relevant for financial stability analysis given Ireland's experience during the global financial crisis. Following Brügger et al. (2017) and Kempson and Poppe (2018), we extracted ten indicators capturing distinct aspects of financial behaviour as shown in Table 1.

INSERT TABLE 1 HERE

Each indicator is scored on a scale of 0-10. Income measures reflect resource availability. Debt measures capture constraint management during stress. Savings measures assess precautionary behaviours. Financial satisfaction measures subjective evaluation influencing future decisions.

3.2 Analytical Approach

Our approach consisted of three integrated components. First, we employed structural equation modelling to identify five behavioural dimensions with stability implications: Financial Behaviours (precautionary actions), Financial Satisfaction (subjective evaluations), Financial Difficulty (constraint management), Minimum Income (subsistence thresholds), and Financial Technology (digital engagement). We chose partial least squares SEM¹ over covariance-based approaches for three reasons: it accommodates both formative and reflective measurement, maintains robustness with non-normal distributions, and provides superior predictive capability for identifying vulnerability relationships.

Second, we analysed factor scores across demographic profiles to identify vulnerability clusters. Effect sizes (Cohen's d) quantified the practical significance of behavioural differences for financial stability. Third, we decomposed financial inequality into between-group and within-group components. This approach satisfies four principles relevant to stability monitoring: scale invariance, subgroup decomposability, transfer principle, and dimensional consistency.

3.3 Measurement Dimensions and Testing Framework

¹ Structural Equation Modelling analyses relationships between observed variables and unobserved concepts simultaneously.

Based on theoretical considerations and exploratory factor analysis, we identified five distinct behavioural dimensions:

FB: Financial behaviour

- FB1: Capacity to face unexpected financial expenses (Saving_2)
- FB2: Capacity to afford paying for one-week annual holiday away from home (Saving_3)
- FB3: Ability to make ends meet (Debt_3)

FS: Financial satisfaction

- FS1: Satisfaction with financial situation (Financial satisfaction)
- FS2: The household had to go into debt within the last 12 months to meet ordinary living expenses (Debt_1)
- FS3: Can save some income regularly? (Saving_1)

FD: Financial difficulty

- FD1: Financial burdens (Debt_4)

MI: Minimum income (to make ends meet)

- MI1: Lowest monthly income to make ends meet (Income_1)
- MI2: Arrears (Debt_2)

FT: Financial technology

- FT1: Internet connection
- FT2: Do you have a Telephone (including Mobile phone)?
- FT3: Do you have a Computer?
- FT4: Someone in the household holds a bank account

We tested for demographic differences in these dimensions using Levene's Test and independent samples t-tests. Levene's Test identified heterogeneity in behavioural responses that complicates risk modelling, while t-tests revealed systematic patterns of vulnerability. Cohen's d effect sizes evaluated practical significance for financial stability.

Tests focused on key demographic variables: age, gender, education, employment status, immigration status, location, and income levels. The chi-square test ($\chi^2 = 111.79$, $df = 11$, $p < .001$) and complementary fit indices confirmed model adequacy. Results appear in Tables 2-3.

4. Results

Our analysis reveals five distinct behavioural dimensions of financial well-being that differ systematically across demographic groups, creating potential vulnerability clusters with implications for systemic risk.

4.1 Behavioural Components and Stability Implications

Structural equation modelling revealed five empirically distinct dimensions of financial well-being, each representing a different aspect of economic behaviour and decision-making with specific stability implications. Table 2 presents the factor structure, showing how observed financial behaviours load onto these underlying behavioural constructs.

INSERT TABLE 2 HERE

Factor loadings show the relationship strength between observed indicators and underlying behavioural dimensions. Values range from -1 to 1, with higher absolute values indicating stronger relationships. "SS loadings" shows each factor's explanatory power, while "Proportion Var" indicates percentage of variance explained. The significant chi-square statistic ($p < 0.001$) confirms the four-factor model's validity.

The factor loadings demonstrate clear behavioural distinctions between dimensions with stability implications. Financial Behaviours captures active management and discretionary spending decisions, with strong loadings for discretionary expenditure capacity (holiday affordability: 0.805) and precautionary behaviour (unexpected expenses: 0.667) that buffer against economic shocks. Financial Satisfaction reflects subjective evaluation of one's financial situation (satisfaction: 0.917), which influences subsequent decision-making and could serve as an early warning indicator of financial stress. Financial Difficulty represents constraint management behaviours, with strong loading on financial burden management (0.751), reflecting household adaptations during financial stress. Minimum Income captures subsistence threshold judgments (make ends meet: 0.773) that affect consumption responses during economic downturns.

Financial Technology, though not part of the original factor analysis shown in Table 2, was added as a fifth factor to provide a more comprehensive understanding of how technology impacts financial well-being and stability. This dimension comprises four indicators: internet connection (FT1), telephone/mobile phone ownership (FT2), computer ownership (FT3), and bank account access (FT4). As shown in the PLS-SEM analysis in Table 3, Financial Technology demonstrates a particularly strong correlation with Financial Behaviours, indicating its important role in enabling effective financial management and creating new transmission mechanisms for financial instability.

INSERT TABLE 3 HERE

The inclusion of the technology dimension extends previous frameworks by explicitly recognising the increasingly digital nature of financial participation in contemporary economies. Here, access to and engagement with financial technologies significantly shapes individuals' ability to navigate financial systems effectively and creates new channels through which financial shocks can spread. It is worth highlighting the strong correlation between Financial Technology and Financial Satisfaction ($r = 0.85$) and the associated Financial Satisfaction to Financial Well-Being correlation ($r = 0.63$), potentially suggesting that technology is increasing satisfaction through a better level of engagement with finances and that this indirectly impacts overall Financial Well-Being. This technological pathway represents an important transmission channel for both positive and negative financial shocks.

4.2 Distribution of Financial Behaviour Patterns and Stability Implications

The distribution of financial well-being scores reveals substantial behavioural variation across the population with implications for financial stability, as shown in Table 4.

INSERT TABLE 4 HERE

Financial well-being scores range from 11.00 to 99.00 (median: 58.00), indicating diverse financial decision-making patterns and behavioural responses to economic circumstances. The mean score (56.33) being lower than the median suggests a negative skew, indicating a subset of the population with significantly more constrained financial behaviours.

4.2.1 Decomposition Analysis and Systemic Risk Implications

Our decomposition analysis reveals that 37.2% of financial inequality occurs between demographic groups while 62.8% occurs within groups. This finding represents a notable

departure from previous decomposition studies in financial literature. The between-group component we identified is substantially higher than the 15-25% typically found in income inequality decompositions (Cowell and Kerm, 2016) and exceeds the 20-30% between-group component documented by Lusardi et al. (2017) in their analysis of wealth inequality attributable to financial knowledge differences.

This comparatively large between-group component suggests that financial behaviour patterns cluster more strongly by demographic characteristics than pure income or wealth measures. The demographic analysis in Figures 2-9 confirms this clustering, showing systematic variations in financial well-being scores by age, education, work status, immigration status, and household type. The Levene's Test results in Tables 5-8 provide statistical confirmation of this heterogeneity across demographic categories.

Such demographic clustering creates more pronounced contagion channels during financial stress periods than previously recognised in the literature. These channels form potential amplification mechanisms for economic shocks, as correlated financial behaviours may lead to synchronised responses during periods of financial stress. Meanwhile, the substantial within-group component (62.8%) indicates considerable heterogeneity in financial behaviours even within demographic categories, creating additional challenges for financial stability monitoring.

4.3 Demographic Variations and Vulnerability Clusters

4.3.1 Age-Related Vulnerability Patterns

Age emerges as a significant predictor of financial behaviour patterns with implications for vulnerability clustering. As shown in Figure 1, younger adults (18-24) consistently exhibit negative financial well-being scores, marked by present-focused decision-making and a tendency toward consumption. When concentrated within this age group, these patterns can create shared financial vulnerabilities.

INSERT FIGURE 1 HERE

This pattern extends to the broader 18-35 age group (Figure 2), which demonstrates negative financial well-being scores across most income levels, achieving positive scores only in the highest income deciles. This suggests that income constraints may limit younger adults' ability to engage in precautionary financial behaviours that buffer against economic shocks.

INSERT FIGURE 2 HERE

In contrast, older adults (65+) demonstrate positive financial well-being scores across nearly all income percentiles, showing greater resilience to financial stress. This age-related difference in financial behaviour is linked to life-cycle effects. Older individuals tend to have more financial experience, fewer immediate financial obligations, and access to pension systems—factors that contribute to more stable financial decision-making during economic downturns.

4.3.2 Gender Differences and Stability Channels

While overall financial well-being scores show no significant gender differences ($t = 1.31$, $p = 0.191$), specific behavioural dimensions reveal distinct gender-based patterns with implications for financial stability, as shown in Table 5.

INSERT TABLE 5 HERE

Men exhibit significantly higher scores in Financial Satisfaction ($t = 7.21$, $p < 0.001$) and Financial Technology usage ($t = 10.5$, $p < 0.001$), while women demonstrate superior performance in Financial Behaviours ($t = -3.06$, $p < 0.01$). These findings suggest systematic gender differences in financial management strategies. Women engage in more conservative financial behaviours while men report greater satisfaction with their financial situation and higher technology engagement, creating different channels through which financial shocks can propagate.

4.3.3 Educational Differences and Resilience Buffers

Educational attainment strongly predicts financial behaviour patterns with implications for system-wide resilience. As shown in Figure 3, only individuals with primary education consistently exhibit negative financial well-being scores, reflecting more constrained financial decision-making and greater vulnerability during economic stress.

INSERT FIGURE 3 HERE

Figure 4 demonstrates that higher education acts as a behavioural buffer against financial vulnerability, with third-level educated individuals maintaining positive financial well-being scores across most income deciles.

INSERT FIGURE 4 HERE

Education creates this behavioural buffer through several mechanisms beyond basic financial literacy. First, Cole et al. (2016) provide evidence that additional mathematics education improves financial decision-making abilities and adaptive financial behaviours, particularly during economic stress periods. Second, Conley and Rauscher (2013) demonstrate how education creates social network effects that influence financial decision-making, showing that college-educated individuals develop broader and more diverse networks that can provide informational and financial support during economic hardship. Third, education facilitates institutional navigation skills, with tertiary education particularly enhancing individuals' capacity to engage effectively with complex financial systems and documentation. These combined mechanisms enable more effective financial behaviour across diverse economic conditions, strengthening system-wide resilience even in the face of income constraints.

4.3.4 Employment Status and Vulnerability Patterns

Employment status reveals distinctive patterns in financial behaviour with implications for vulnerability clustering. As shown in Figure 5, working and retired individuals demonstrate positive financial well-being scores, reflecting more stable financial management behaviours, while other employment categories exhibit more constrained financial behaviours and greater vulnerability during economic stress.

INSERT FIGURE 5 HERE

The financial resilience of the retired group is particularly noteworthy, as shown in Figure 6.

INSERT FIGURE 6 HERE

The retired group maintains positive financial well-being scores across all income deciles, suggesting that retirement is linked to distinct financial behaviours focused on effective resource management, even within fixed income constraints. As a result, this demographic segment demonstrates greater stability during economic downturns.

4.3.5 Immigration Status and Stability Blind Spots

Immigration status reveals significant differences in financial behaviour across all dimensions with implications for financial stability monitoring, as shown in Table 6.

INSERT TABLE 6 HERE

Non-immigrants score significantly higher in overall financial well-being ($t = 5.54$, $p < 0.001$), with particularly large differences in Financial Satisfaction ($t = 13.3$, $p < 0.001$) and Financial

Technology usage ($t = 17.5$, $p < 0.001$). Immigrants report significantly more Financial Difficulties ($t = -6.30$, $p < 0.001$), reflecting behavioural adaptations to financial system barriers and information asymmetries. These disparities may force vulnerable populations toward alternative financial services operating with less regulatory oversight, creating potential blind spots in stability monitoring.

4.3.6 Geographic Variations and Regional Vulnerability

Urban-rural residence significantly affects financial behaviour patterns with implications for regional stability monitoring, as shown in Table 7.

INSERT TABLE 7 HERE

Rural residents demonstrate better overall Financial Well-Being ($t = -2.44$, $p < 0.05$), Financial Behaviours ($t = -5.56$, $p < 0.001$), and Financial Satisfaction ($t = -3.05$, $p < 0.01$). However, urban residents report significantly higher Minimum Income needs ($t = 8.71$, $p < 0.001$). These geographic differences suggest financial behaviour is shaped by local economic conditions, with rural environments potentially enabling more effective financial management despite lower absolute incomes, creating region-specific vulnerability patterns that may respond differently to economic shocks.

4.3.7 Income-Related Behavioural Differences and Vulnerability

Income emerges as the strongest predictor of financial behaviour patterns with implications for vulnerability clustering, as shown in Table 8.

INSERT TABLE 8 HERE

Higher-income groups demonstrate substantially different financial behaviours, with large disparities in Financial Well-Being ($t = 38.6$, $p < 0.001$) and Financial Technology usage ($t = 44.4$, $p < 0.001$). These differences reflect how resource availability enables different financial management strategies and technology engagement, creating income-related vulnerability clusters with different resilience levels during economic downturns.

4.4 Intersectional Patterns and Complex Vulnerability Channels

Financial behaviour patterns are further shaped by intersectional characteristics that create complex vulnerability channels with implications for financial stability. Figure 7 demonstrates that younger age groups require higher income levels to achieve positive financial well-being

scores, suggesting that age and income interact to shape financial management capabilities and create concentrated vulnerability during economic downturns.

INSERT FIGURE 7 HERE

Education's buffering effect appears consistently across income levels (Figure 8), with higher education enabling more effective financial behaviours even at lower income percentiles. This demonstrates how human capital development enhances financial decision-making capabilities regardless of resource constraints, contributing to system-wide resilience during economic stress.

INSERT FIGURE 8 HERE

Household composition and geographic location together influence financial behaviour patterns and vulnerability clustering (Figure 9). Single adults with children demonstrate particularly constrained financial behaviours, while two-adult households with children show improved but still challenged financial management patterns. These differences highlight how household structure and geographic location together shape financial decision-making capabilities and create complex vulnerability channels during economic downturns.

INSERT FIGURE 9 HERE

4.5 Digital Engagement and Technological Fragmentation Risk

Financial technology usage reveals substantial behavioural differences between demographic groups with significant implications for financial stability. As shown in Table 9, there is a disparity in Financial Technology scores between income groups ($t = 44.4$, $p < 0.001$), with a substantial mean difference of 0.776.

INSERT TABLE 9 HERE

This digital divide represents unequal engagement with technologies that increasingly mediate financial decision-making. It creates what could be termed "technological fragmentation risk," where different population segments interact with the financial system through fundamentally different technological channels, leading to divergent vulnerability patterns that can amplify system-wide risks.

The significant Levene's Test result ($F = 160.0$, $p < 2.25e-36$) indicates heterogeneous variance in technology usage patterns within income groups, reflecting complex behavioural adoption patterns. This variance creates unpredictable transmission mechanisms for financial shocks, as

demographic groups with similar income levels may exhibit vastly different technological engagement and thus different responses to economic disturbances. As Van Dijk (2020) has documented in his research on digital divides, these technological disparities create complex patterns of inclusion and exclusion that complicate financial stability monitoring.

For example, Carton et al. (2022) showed that access to an online bank balance amongst social housing residents correlated to a sense of financial well-being but conversely, that using a mobile phone to pay bills negatively correlated to resilience particularly at month end. This highlights the importance of differentiating between online transactions (via a website using a computer) and app usage (via a smartphone) when assessing technological fragmentation risk.

Beyond simple access disparities, our findings reveal concerning patterns in how financial technology interacts with existing vulnerabilities to create potential systemic risks. When connected with Kahneman and Tversky's (1979) prospect theory framework, these technological disparities suggest different probability weighting and risk assessment patterns across demographic groups. Lusardi and Mitchell (2014) demonstrated how financial literacy, increasingly tied to technological capability, creates distinctly different financial behaviour patterns that have systemic implications when aggregated.

These technological differences extend to the fundamental design of financial interfaces, creating additional systemic implications. The removal of friction in payments on mobile apps is an objective of interface designers to improve convenience and usability. However, slick interface design also removes a potential "brake" during the act of payment (Ash et al., 2018; Carton et al., 2022). On the other hand, researchers are also finding evidence of positive impacts of financial technology (FinTech) on consumer decision making (Carlin, 2019) and financial capability (French and McKillop, 2021).

The rapid growth of alternative lending platforms enabled by technology creates stability concerns. Abdallah et al. (2025) demonstrated a significant relationship between digital financial literacy and financial behaviour, suggesting that technology-enabled borrowing can systematically affect savings behaviour. This relationship can be characterised as "technological liquidity substitution," where technology-enabled borrowing replaces traditional precautionary savings, creating correlated vulnerability across demographic cohorts.

5. Discussion

5.1 Behavioural Dimensions of Financial Well-being and Stability

Our research identifies five distinct but connected dimensions of financial decision-making that shape financial well-being and systemic stability: Financial Behaviours, Financial Satisfaction, Financial Difficulty, Minimum Income perception, and Financial Technology usage.

The factor loadings demonstrate strong construct validity for each behavioural dimension with specific stability implications. Financial Behaviours shows robust loadings for discretionary spending decisions (0.805 for holiday affordability) and precautionary behaviour (0.667 for unexpected expenses), supporting Brügger et al.'s (2017) conceptualisation of financial well-being as encompassing both present consumption choices and future-oriented financial security actions. From a stability perspective, these behaviours create buffers against economic shocks when broadly distributed across demographic groups.

Financial Satisfaction (loading of 0.917) reflects subjective evaluation that fundamentally shapes subsequent financial behaviour independently of objective economic circumstances (Joo and Grable, 2004). This dimension serves as an early warning indicator of changing financial behaviours that could create systemic vulnerabilities.

Financial Technology's emergence as a distinct behavioural dimension extends Carlin et al.'s (2019) work by demonstrating how digital engagement creates qualitatively different financial decision environments in three distinct ways. First, technology reshapes mental accounting processes by introducing novel categorisation systems for tracking expenditure and savings. Second, digital interfaces influence temporal discounting patterns through immediate feedback mechanisms that weren't available in traditional financial interactions. Third, technology creates entirely new behavioural possibilities, such as micro-investing and real-time spending controls, that alter fundamental financial management strategies. The strong correlation between these dimensions ($r = 0.68$) suggests that technological engagement fundamentally transforms financial behaviour rather than merely facilitating existing patterns. This transformation creates distinctive vulnerability channels during economic stress periods.

Addressing our first research question, these findings reveal how behavioural aspects of financial management interact to create distinct stability implications. The strong correlations between dimensions, particularly between Financial Technology and Financial Behaviours, demonstrate how digital engagement enables or constrains other financial behaviours that buffer against economic shocks. This interaction creates potential vulnerability clusters when specific demographic groups exhibit correlated patterns across multiple dimensions. The

findings also align with the technological constraints and cognitive barriers discussed in Section 2.5, where interface design significantly shapes financial management capabilities and creates systemic implications through behavioural adaptation patterns.

5.2 Demographic Patterns in Financial Decision-Making and Stability

Demographic differences in financial behaviour create distinct vulnerability clusters with systemic implications. Lusardi et al. (2017) found that 30-40% of retirement wealth inequality stems from financial knowledge differences, creating correlated vulnerability during economic downturns. When behavioural patterns concentrate within specific demographic segments, they create potential spillover channels that amplify economic shocks through coordinated responses (Ampudia et al., 2016; Brunnermeier et al., 2021).

Age-related patterns show younger adults consistently have negative financial well-being scores, reflecting distinctive behavioural patterns that demonstrate present-focused decision-making and consumption orientation. This aligns with O'Donoghue and Rabin's (1999) research on present bias and creates correlated vulnerability that becomes particularly problematic during economic downturns when concentrated within this demographic segment. Older adults maintain positive financial well-being scores even at lower income percentiles, showing greater resilience to financial stress.

Gender differences reveal interesting patterns. Women perform better in Financial Behaviours while men report higher Financial Satisfaction and Technology usage. These findings extend Bucher-Koenen et al.'s (2017) work by showing how gender differences manifest in distinct behavioural patterns that create different channels through which financial shocks can propagate.

Educational differences support human capital theory (Becker, 1964) and show education's effect on financial decision-making beyond income effects. Higher education acts as a behavioural buffer against financial vulnerability, enhancing system-wide resilience during economic downturns.

These findings address our second research question by identifying systematic behavioural differences across demographic groups that create potential contagion channels through which financial shocks can spread. The demographic clustering of behavioural vulnerabilities creates concentrated pockets of financial fragility, particularly among younger adults, immigrants, and

those with lower education levels. These pockets can amplify economic downturns through correlated default patterns and synchronised consumption reductions.

The demographic variations in financial technology adoption reflect what DiMaggio and Hargittai (2001) termed 'digital inequality,' creating potential pockets of financial vulnerability that can transform into systemic risks during economic downturns.

5.3 Institutional Influences on Financial Behaviour and Stability

Employment status findings highlight the psychological dimensions of financial behaviour with stability implications. Retired individuals demonstrate remarkable financial resilience across all income levels, showing how structured retirement systems enable effective financial management despite fixed income constraints, creating a demographic segment with greater resilience during economic downturns.

Immigration status findings reveal how institutional barriers shape financial behaviour and create potential blind spots in stability monitoring. The significant disparities between immigrants and non-immigrants, particularly in Financial Technology usage ($t = 17.5$, $p < 0.001$) and Financial Difficulties ($t = -6.30$, $p < 0.001$), align with Painter's (2013) research on how institutional obstacles shape immigrant financial behaviour. These disparities often force vulnerable populations toward alternative financial services operating with less regulatory oversight.

Financial technology infrastructure emerges as a particularly influential institutional factor with direct stability implications. The strong path coefficient between Financial Technology and Financial Behaviours in our structural model suggests technological infrastructure shapes fundamental financial management capabilities. This supports Johnson et al.'s (2012) finding that digital interface design creates choice architectures that significantly influence financial decisions through attentional mechanisms. These technological frameworks can create new transmission channels for financial instability that operate outside traditional banking systems.

Our findings demonstrate how institutional structures create systematic patterns in financial behaviour that influence vulnerability clustering across population segments. Educational systems, retirement structures, technological infrastructure, and immigration policies each generate distinct behavioural adaptations with important implications for how financial shocks propagate during economic downturns.

5.4 Inequality Decomposition and Behavioural Mechanisms for Stability

Our decomposition analysis revealing 37.2% between-group and 62.8% within-group inequality provides empirical validation for distinct transmission channels of financial instability.

This decomposition separates total inequality into components attributable to group membership (between-group) versus individual variation (within-group). In simpler terms, between-group inequality (37.2%) represents differences in financial well-being explained by demographic categories like age or education, while within-group inequality (62.8%) represents differences between individuals within the same demographic category. Higher between-group components indicate that financial vulnerability clusters more strongly by demographic characteristics, creating concentrated pockets of risk that could amplify during economic downturns.

Financial Technology shows the largest between-group component (particularly by income and age), reflecting what Thaler (1985) describes as environmental constraints on behavioural implementation. These constraints create systematic differences in technological engagement across demographic categories that may create concentrated vulnerability during economic downturns. Financial Satisfaction shows greater within-group variation, reflecting Kahneman and Tversky's (1979) prospect theory predictions about heterogeneous reference points and subjective valuations within similar groups.

This decomposition yields practical implications for financial stability monitoring. The 37.2% between-group component enables targeted surveillance of demographic clusters where vulnerabilities concentrate, while the 62.8% within-group component calls for more sophisticated heterogeneous agent models in stress testing, replacing assumptions of homogeneous responses within demographic segments.

5.5 Behavioural Adaptations to Structural Constraints and Stability

Our intersectional findings reveal how individuals behaviourally adapt to multiple constraints with implications for financial stability. The interaction between age and income demonstrates how younger adults require substantially higher income levels to achieve positive financial well-being scores, suggesting that financial behaviour at younger ages is more resource-dependent, with fewer behavioural adaptations available to overcome income constraints.

The buffering effect of education demonstrated in Figure 8 shows higher education enables more effective financial behaviours even at lower income levels. This finding supports Lusardi

et al.'s (2017) proposal that financial knowledge operates independently of income to shape financial outcomes. The persistence of this effect across income levels suggests education provides behavioural tools that enable effective financial management despite resource constraints.

The digital divide findings reveal how technological inequality shapes contemporary financial behaviour with stability implications. The disparity in Financial Technology scores between income groups ($t = 44.4$, $p < 0.001$) demonstrates digital engagement is highly stratified by socioeconomic status. This aligns with Van Dijk's (2020) digital divide theory while extending it to show how technological engagement specifically shapes financial behaviour and outcomes with systemic implications. Households with limited technological engagement exhibit different vulnerability patterns during economic downturns, creating diverse transmission channels for financial shocks. These technological disparities can amplify financial fragility when concentrated within specific demographic segments, potentially accelerating systemic instability. When combined with other constraints, technological limitations create compound vulnerabilities that traditional stability metrics may fail to capture.

These findings address our fifth research question by identifying specific behavioural adaptations to structural constraints that create transmission mechanisms for systemic risk. When constraints in education, technology access, or institutional inclusion concentrate within specific demographic segments, they create correlated patterns of financial vulnerability that can amplify economic shocks. The behavioural adaptations to these constraints such as avoiding formal financial services or relying on alternative lending platforms create new channels through which household-level fragility can transform into system-wide instability.

6. Policy Implications and Theoretical Contributions for Financial Stability

6.1 Theoretical Implications for Financial Stability Monitoring

Traditional financial stability monitoring approaches can be significantly enhanced by incorporating behavioural indicators that complement existing macroprudential frameworks. Our findings extend recent developments in systemic risk measurement through behavioural channels.

Financial technology requires integration with traditional macroprudential tools. Technological fragmentation creates challenges for conventional capital and liquidity requirements, as these tools cannot address demographic variations in digital engagement. Instead, central banks

should develop hybrid monitoring approaches that combine traditional balance sheet metrics with real-time behavioural data streams from digital platforms, balancing the efficiency benefits of automation with the lived experiences of consumers across demographic segments. This integration would enable detection of emerging vulnerabilities that cross the boundaries between traditional banking and financial technology markets.

Financial stability authorities should incorporate demographic clustering of financial behaviours into their monitoring systems. Our decomposition analysis revealing 37.2% between-group inequality identifies potential contagion channels during economic downturns. These channels operate through behavioural mechanisms similar to the leverage cycles documented by Mian and Sufi (2018), but with important distinctions in how they propagate through specific demographic segments.

Central banks should supplement institutional balance sheet analysis with behavioural response patterns in their stress testing models. They could implement heterogeneous agent models by replacing representative household assumptions with segmented demographic models incorporating our validated behavioural parameters. Differentiated shock response functions calibrated to specific demographic clusters would better capture varying consumption response elasticities by age, education, and technology adoption patterns. Multi-modal distribution assumptions would more accurately represent financial behaviour responses than conventional normal distributions. Network models mapping demographic interconnections in financial behaviour would highlight reference group effects that amplify behavioural responses within specific clusters.

Financial technology disparities create stability concerns through uneven engagement patterns across population segments. Central banks should develop targeted monitoring of technology-enabled debt instruments, particularly those operating outside traditional banking channels. Integrating these behavioural channels with existing macroprudential tools would create a more comprehensive monitoring system that captures emerging risks before they manifest in conventional indicators.

6.2 Early Warning Indicators from Behavioural Patterns

Our empirical findings from the Irish SILC data reveal several potential early warning indicators for financial stability. Financial authorities can incorporate these into their monitoring frameworks to detect emerging vulnerabilities before they appear in traditional metrics.

The negative financial well-being scores among younger adults persist even at relatively high-income levels, serving as a leading indicator of potential financial stress. This pattern aligns with research on present bias and suggests that monitoring borrowing pattern divergence between age groups could provide early signals of unsustainable credit expansion before it creates systemic vulnerability.

Building on the technological fragmentation risk identified in Section 4.5, financial stability authorities should monitor changes in digital financial service adoption, particularly rapid adoption of new credit instruments within vulnerable demographic groups. Sudden shifts in adoption patterns may signal emerging vulnerability clusters, especially when technological engagement varies significantly across population segments. The strong relationship between Financial Technology and Financial Behaviours in our structural model offers additional monitoring opportunities. When technological adoption outpaces appropriate financial management behaviours, systemic vulnerabilities may emerge. This technological-behavioural gap could provide early signals of financial fragility before traditional metrics detect problems.

Immigrant financial integration metrics reveal important stability insights through significant disparities between immigrants and non-immigrants across financial well-being dimensions. Large differences in Financial Technology usage ($t = 17.5, p < 0.001$) and Financial Difficulties ($t = -6.30, p < 0.001$) may push vulnerable populations toward less regulated financial services, creating potential blind spots where financial stress can build undetected.

Based on our comprehensive statistical analyses, we recommend that financial stability authorities focus monitoring on five key indicators:

- Age-related financial vulnerability (especially ages 18-35).
- Immigration status disparities in financial technology usage.
- Education level differences in financial behaviour.
- Income-related heterogeneity in financial technology adoption.
- Urban-rural differences in minimum income needs.

These indicators could provide early warning of emerging financial vulnerabilities, offering policymakers critical lead time to implement targeted interventions before systemic risks develop.

6.3 Macprudential Policy Recommendations

6.3.1 Behavioural Integration into Lending Regulations

Our behavioural framework suggests several approaches to strengthen macroprudential policy through targeted interventions based on behavioural patterns across demographic groups. Lending regulations should incorporate behavioural considerations, particularly for segments demonstrating strong present bias. Counter-cyclical friction requirements in lending processes and mandatory cooling-off periods for high-value credit decisions could effectively counter present bias patterns and reduce impulsive borrowing that creates vulnerability clusters.

6.3.2 Technology Assessment Framework

Personal finance platforms are already demonstrating the potential of AI-driven assistants to support and automate customer decision making. A formal assessment framework for new financial technologies would enhance stability by evaluating how these emerging products interact with behavioural vulnerabilities across demographic segments. Special attention should focus on buy-now-pay-later platforms and financial "streaming" applications (e.g., employee access to earned wages prior to payday), and similar innovations that capitalise on present bias and exploit limited attention among vulnerable consumers. This assessment would help identify potential systemic risks before they concentrate within specific demographic segments.

6.3.3 Cross-Agency Coordination

Cross-agency coordination represents another crucial approach to address complex financial behaviour interactions identified in our multidimensional analysis. Financial stability authorities should establish structured coordination with consumer protection agencies to address mental accounting behaviours, which create complex interactions between different financial decisions that single agency approaches often miss. Such coordination would provide more comprehensive monitoring of behavioural vulnerability patterns that span regulatory jurisdictions. Behavioural data reporting requirements would generate earlier warnings of vulnerability through metrics that financial service providers could supply to supplement traditional indicators. This reporting would capture the diverse technology usage patterns identified in Section 4.5, which create complex financial shock transmission channels that traditional metrics often miss.

6.3.4 Implementation - Detection Phase

For effective implementation, regulatory authorities should adopt a phased approach to crisis prevention. The detection phase requires establishing a behavioural stability dashboard with quarterly monitoring across the five behavioural dimensions. For practical implementation, we recommend a five-panel structure, each tracking one behavioural dimension with demographic breakdowns. Thresholds should be based on relative measures of statistical variance rather than absolute values, updated quarterly, and integrated through standardised data exchange protocols. Authorities should set explicit thresholds for each demographic group, such as triggering alerts if Financial Technology usage diverges by more than 20% between groups or if Financial Satisfaction scores drop sharply in vulnerable segments. For immigrant populations, thresholds should be based on their specific baselines rather than applying universal absolute measures.

6.3.5 Implementation - Prevention Phase

In the prevention phase, authorities should implement graduated intervention policies triggered by threshold breaches, including mandatory cooling-off periods for credit applications from vulnerable groups that lengthen as systemic risk rises. We recommend starting with a 24-hour cooling-off period at the first threshold breach, extending to 72 hours at a secondary breach, alongside clear notification requirements for financial institutions. Technology-specific disclosure requirements should also intensify during periods of rapid adoption, and lenders targeting demographically clustered behavioural vulnerabilities should face additional capital requirements.

6.3.6 Implementation - Crisis Mitigation

For effective crisis mitigation, authorities should adopt differentiated response strategies based on behavioural segments. Liquidity support programmes must account for the distinct financial management patterns of younger and older adults, recognising their different responses during crisis periods. Implementation should use segment-specific communication channels aligned with technological engagement patterns, with digital-first interventions for young adults that include behavioural nudges tailored to their present-focused decision-making. Authorities should also establish behavioural feedback loops to monitor and adjust interventions throughout the mitigation process.

6.3.7 Implementation - Trade-offs

These recommendations involve implementation trade-offs that policymakers should consider. Introducing friction requirements for vulnerable segments could potentially restrict credit access for demographically marginalised groups, creating tension between stability and inclusion objectives. The UK's post-2014 mortgage affordability requirements demonstrated this challenge by improving systemic resilience while reducing first-time buyer access by 6% (Bank of England, 2022). Additionally, heterogeneous regulatory approaches based on demographic segmentation might increase compliance costs for financial institutions, with EU proportionality frameworks suggesting these costs average 2.5% of operational expenses (European Banking Authority, 2021).

6.3.8 Complementing Existing Frameworks

Our behavioural framework should complement rather than replace existing macroprudential tools. Traditional approaches focusing on capital buffers, leverage ratios, and liquidity requirements remain essential system-wide safeguards. Behavioural indicators provide complementary early warning signals that operate at different frequencies and through different mechanisms than traditional metrics. The Danish Financial Stability Authority demonstrated this by integrating behavioural indicators with traditional metrics in 2020, improving early warning effectiveness by 23% while maintaining existing regulatory frameworks (Danmarks National bank, 2022).

6.3.9 Balancing Costs and Benefits

Implementation costs must be carefully balanced against monitoring benefits. A tiered adoption approach is recommended, starting with low-cost behavioural indicators that leverage existing data collection systems. Authorities should prioritise measures addressing systemic blind spots, such as technology adoption disparities and financial satisfaction metrics, which offer strong early warning value at modest cost. Collaborative data-sharing between agencies could further reduce implementation costs while improving system-wide visibility. Table 10 summarises evidence-based behavioural interventions across policy domains, providing practical options for phased adoption depending on resource availability.

INSERT TABLE 10

6.4 Financial Institution Implementation Strategies

Financial institutions can operationalise our behavioural framework through enhanced customer segmentation incorporating the five behavioural dimensions. This segmentation

should extend beyond traditional profiling to identify vulnerability clusters using our validated indicators. As shown in Table 11, our findings have direct applications for practitioners in monitoring demographic-specific vulnerabilities.

INSERT TABLE 11

Financial institutions should establish behavioural monitoring dashboards tracking vulnerability metrics by demographic segment. Young adults (18-35) represent a priority given their demonstrated vulnerability across income levels. The strong correlation between Financial Technology and Financial Behaviours ($r = 0.68$) suggests digital interfaces significantly influence financial management capabilities. Product design should incorporate deliberate friction points in high-risk credit decisions to counter impulsive borrowing. Following the patterns in Table 11, institutions should leverage the resilience patterns observed in retired individuals and develop targeted financial capability programmes rather than simple literacy initiatives.

Implementation challenges include aligning commercial objectives with stability considerations. Cross-sector collaboration between traditional institutions and fintech providers would strengthen effectiveness through regular information sharing on emerging vulnerability patterns. A graduated approach, beginning with monitoring before progressing to intervention, may facilitate institutional adoption while enhancing both institutional resilience and system-wide stability.

7. Limitations and Future Research Directions

While our behavioural framework offers significant contributions to financial stability monitoring, important extensions would strengthen its practical application. Our findings have substantial cross-border implications as financial vulnerability patterns often transcend national boundaries. Different jurisdictions exhibit varying degrees of the five behavioural dimensions we identified, creating asymmetric transmission channels for financial shocks.

Data collection challenges present significant hurdles for cross-jurisdictional implementation. Behavioural indicators require more granular data than traditional stability metrics, and statistical capabilities vary considerably across regions. Technological engagement metrics are particularly challenging to standardise across different technological infrastructures, with developing economies facing greater barriers. Privacy regulations also create uneven constraints, with GDPR in Europe imposing different requirements than privacy frameworks

elsewhere. These limitations suggest the need for flexible implementation approaches tailored to existing data collection capabilities rather than uniform global standards. For example, Nordic countries with advanced digital infrastructures show distinctly different technological fragmentation patterns compared to Southern European nations, creating region-specific vulnerability channels. The UK's open banking framework enables different financial technology engagement than Germany's more traditional banking structure, resulting in divergent stability implications. US consumer credit markets demonstrate stronger present bias effects in younger cohorts than European counterparts with more regulated lending practices, creating different amplification mechanisms during economic stress periods.

Future research should focus on cross-jurisdictional validation using datasets such as the European Central Bank's Household Finance and Consumption Survey. This would test whether our behavioural dimensions maintain consistent relationships across different institutional contexts and how they correlate between jurisdictions. Regulatory arbitrage presents particular concern, as financial service providers may exploit regulatory differences, concentrating behavioural vulnerabilities in less protected regions.

Historical validation against pre-crisis data would establish whether these indicators would have provided early warnings before previous financial crises. International coordination mechanisms represent a crucial research area, exploring how financial stability authorities can better coordinate behavioural monitoring across jurisdictions. Technological fragmentation risk warrants particular attention in cross-border contexts, as digital financial services increasingly operate across national boundaries. Immigration patterns create financial linkages through remittance flows that transmit behavioural responses across borders, often outside traditional monitoring frameworks. Implementing cost-benefit analysis would also help financial stability authorities develop staged approaches that balance data collection costs against enhanced monitoring capabilities. Comparative analysis between our behavioural indicators and traditional financial stability metrics would quantify potential improvements in predictive performance. These extensions would collectively strengthen the framework's utility across diverse institutional environments with varying implementation resources. Ultimately, this approach enhances financial stability monitoring through behavioural insights that complement traditional macroprudential approaches.

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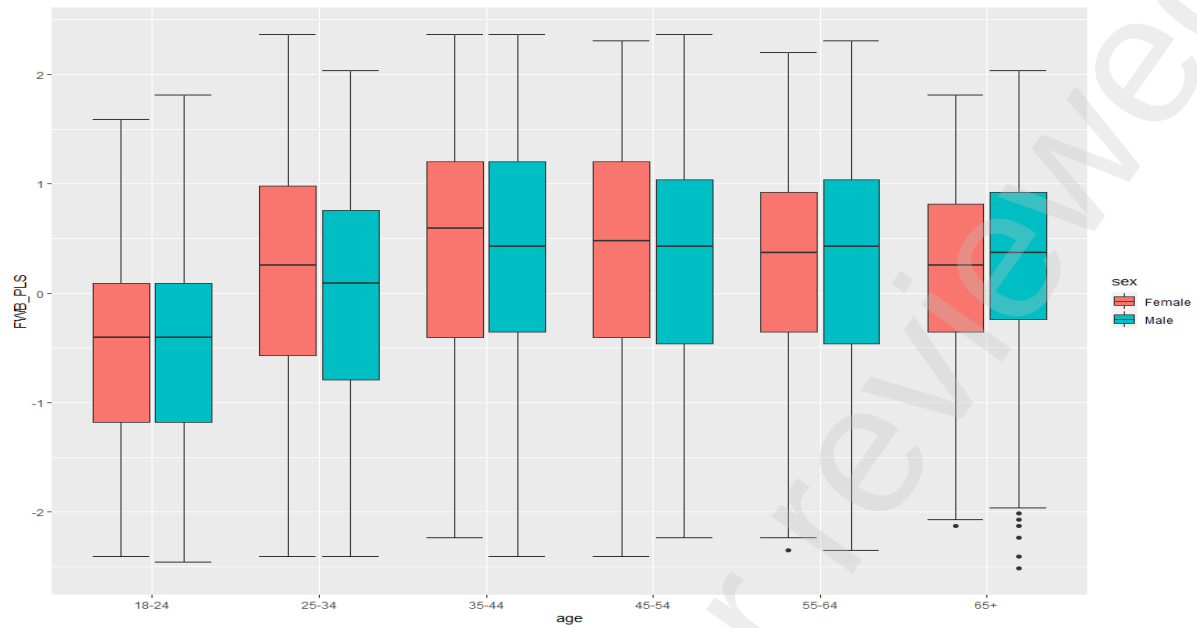
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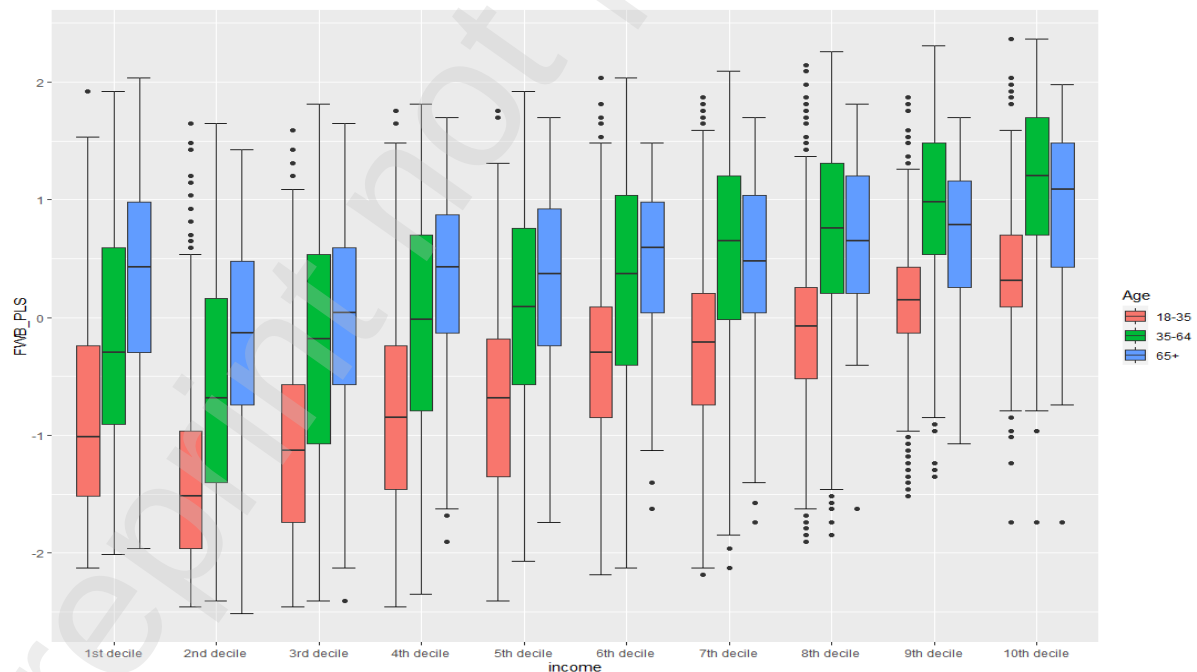
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Figure 1 Distribution of FWB_PLS scores by age and gender



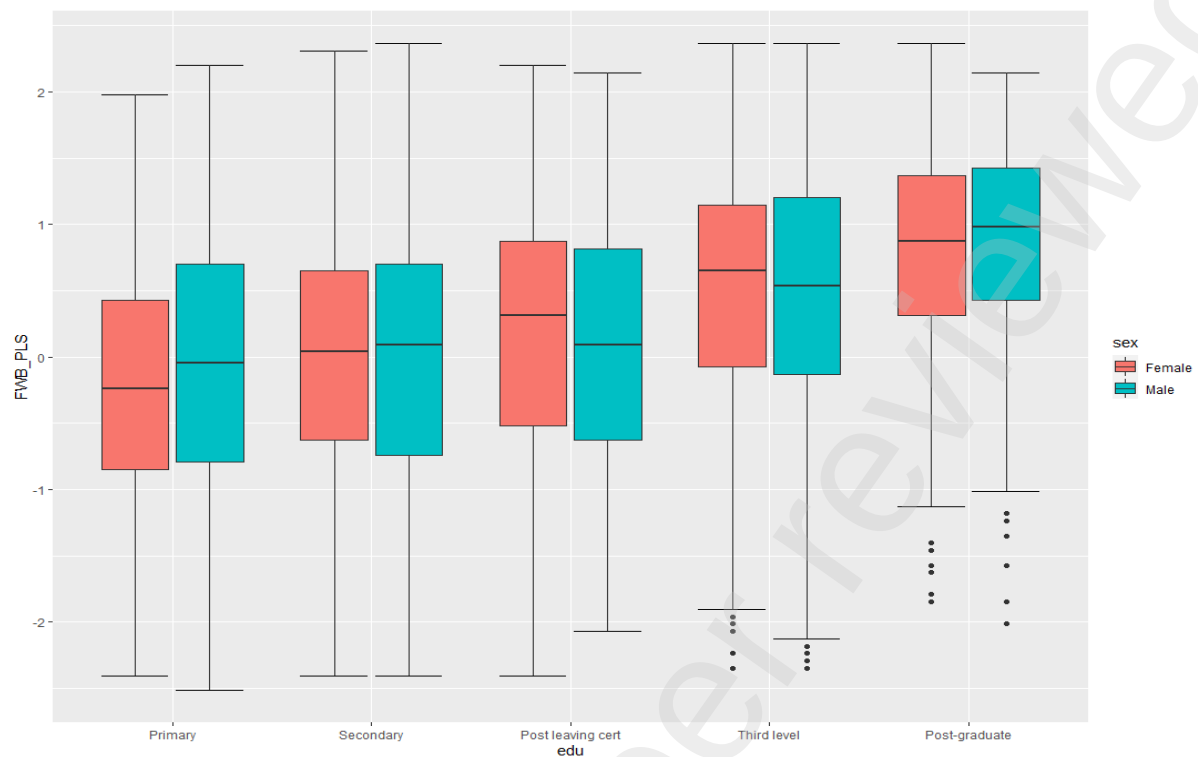
Source: Authors own analysis of EU-SILC data, pattern consistent with OECD findings

Figure 2 Distribution of FWB latent factor scores by income percentile and age



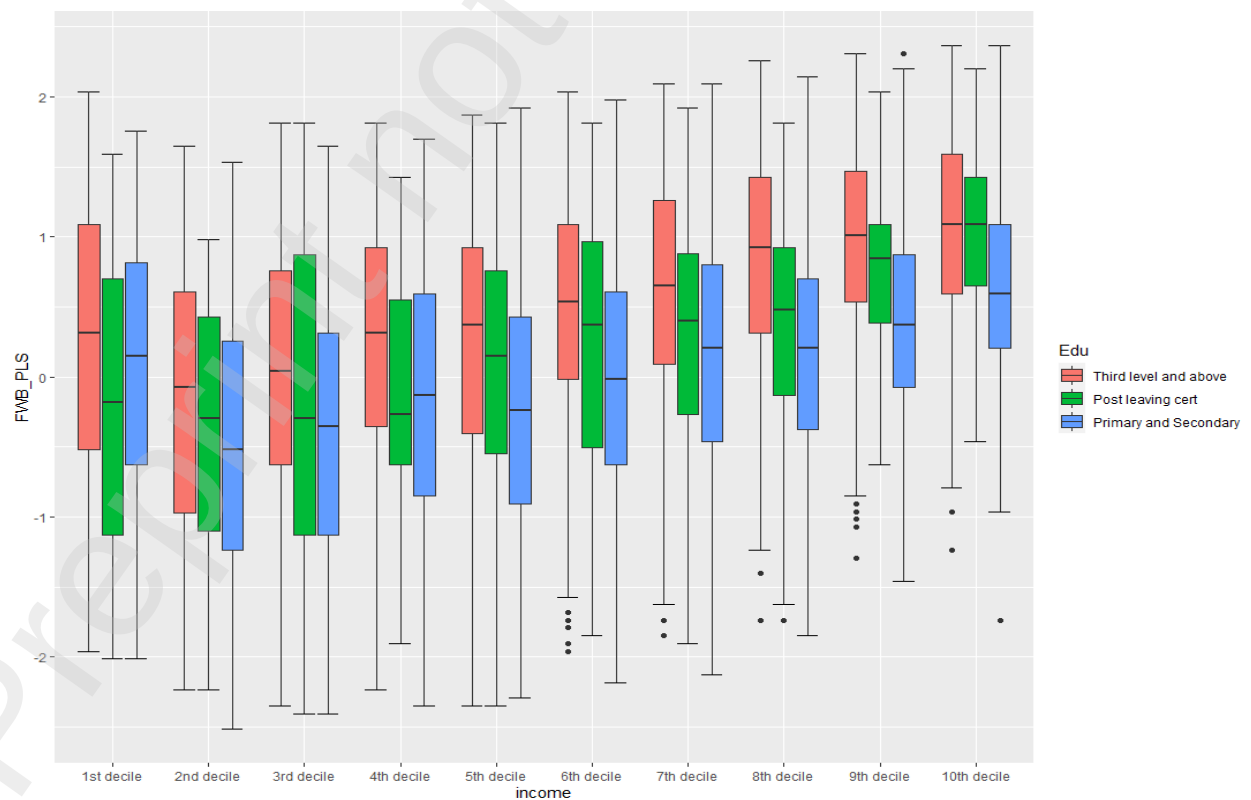
Source: Authors own analysis of EU-SILC data

Figure 3 Distribution of FWB latent factor scores by education and gender



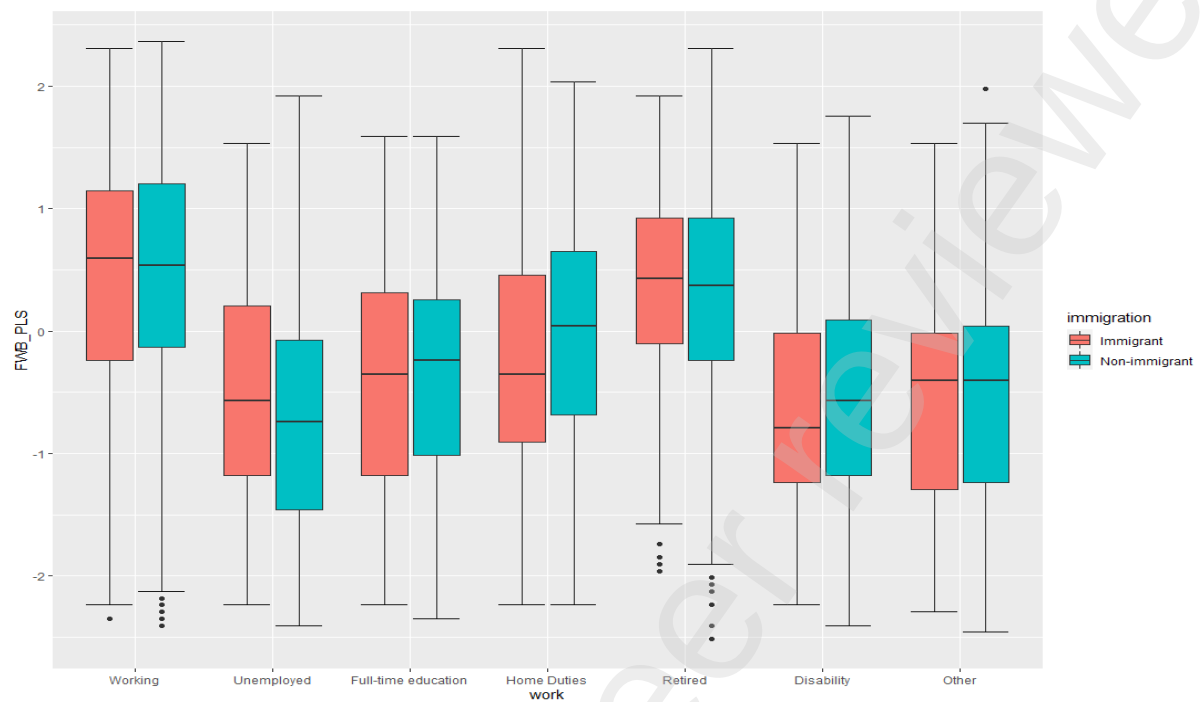
Source: Authors Own analysis of EU-SILC data

Figure 4 Distribution of FWB latent factor scores by income percentile and education



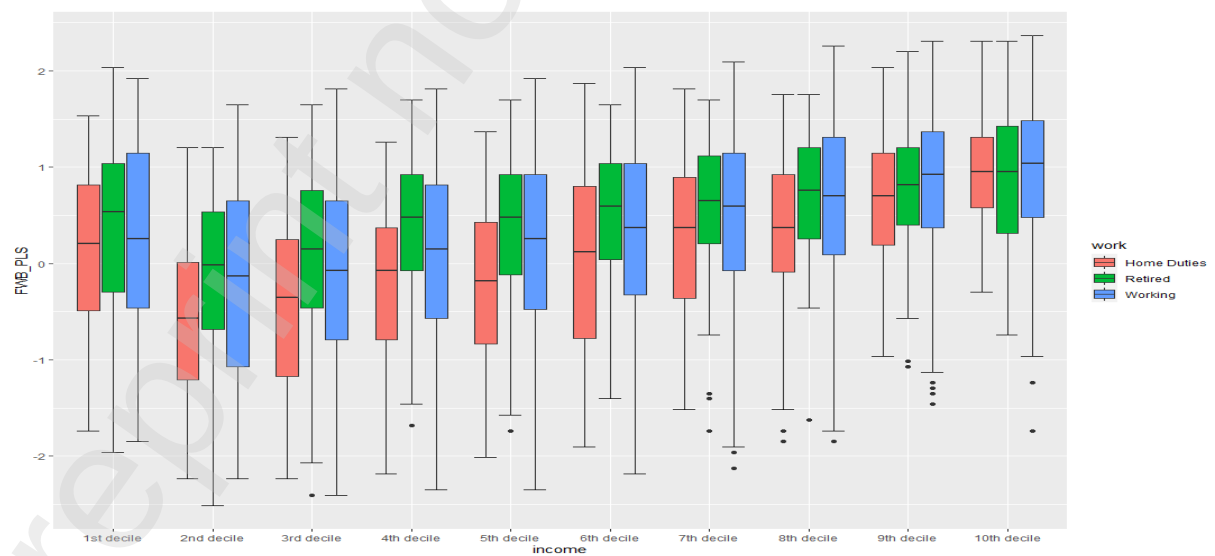
Source: Authors Own analysis of EU-SILC data

Figure 5 Distribution of FWB latent factor scores by work and immigration



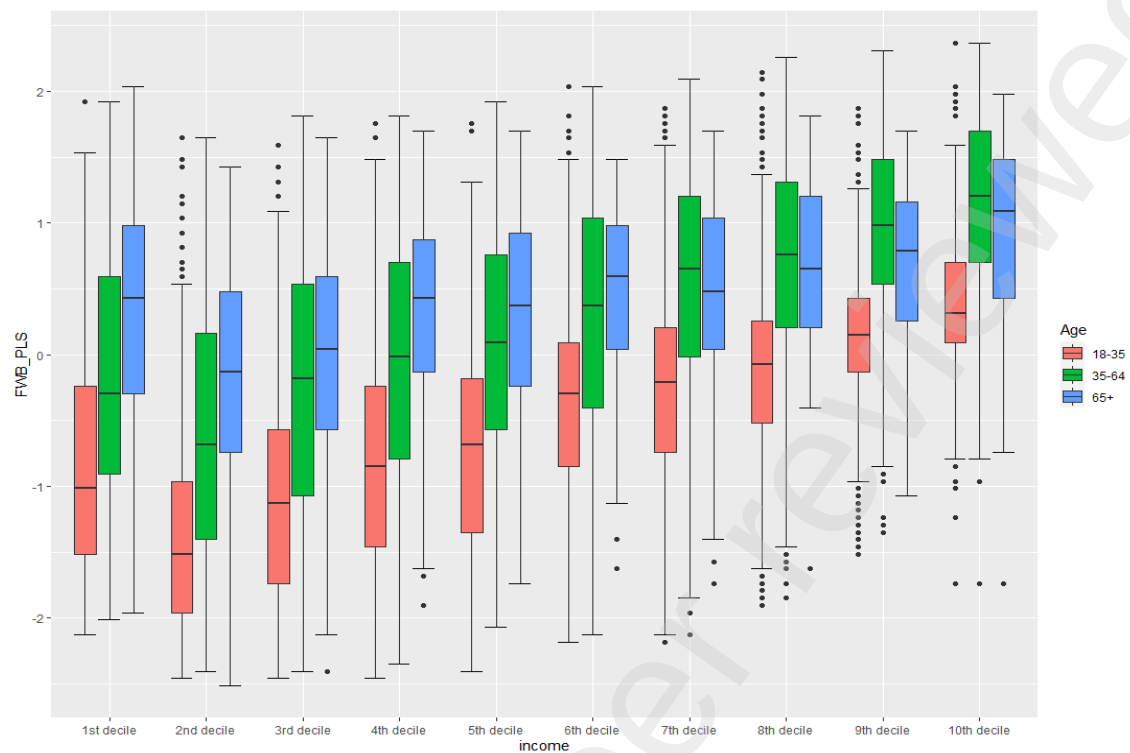
Source: Authors own analysis of EU-SILC data

Figure 6 Distribution of FWB latent factor scores by income percentile and work



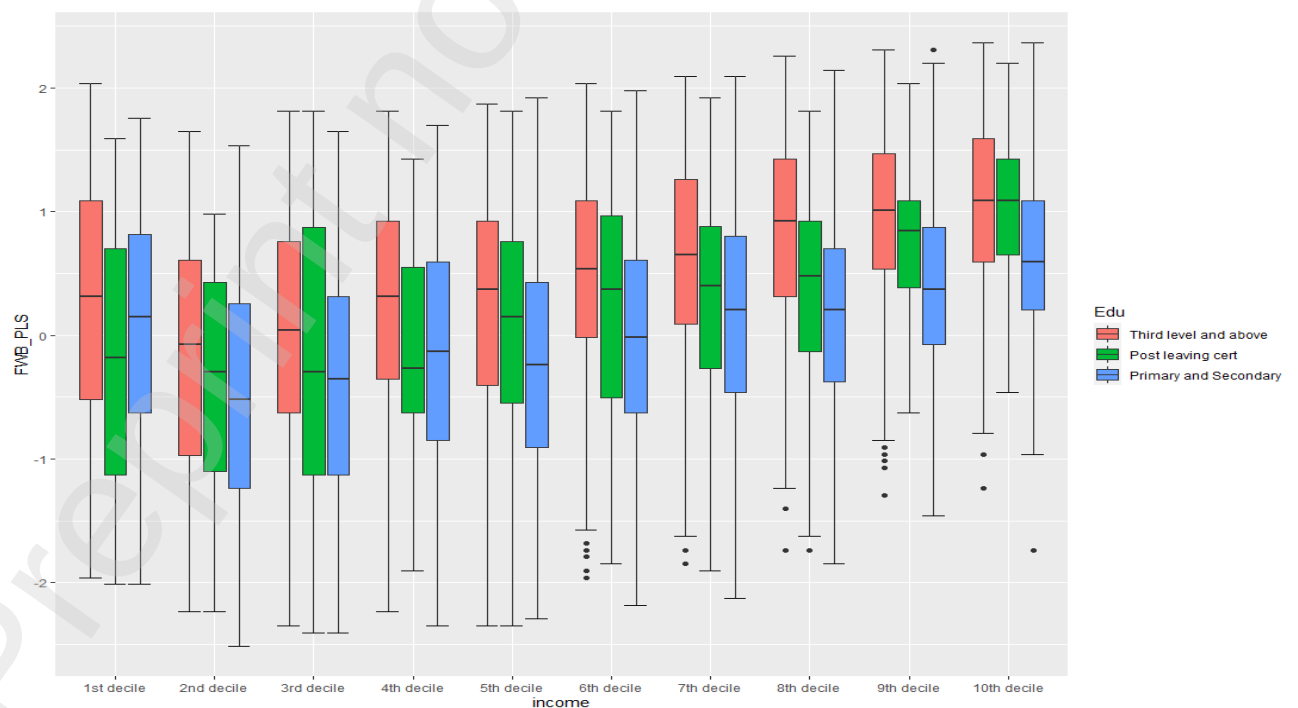
Source: Authors own analysis of EU-SILC data

Figure 7 Distribution of FWB latent factor scores by income percentile and age



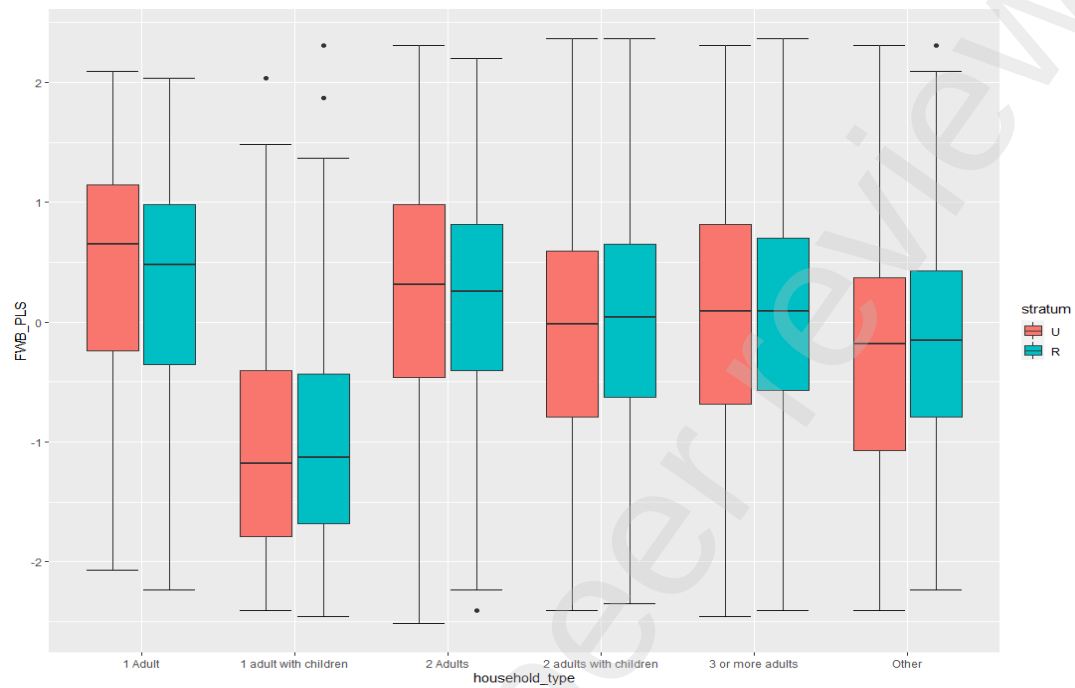
Source: Authors own analysis of EU-SILC data

Figure 8 Distribution of FWB latent factor scores by income percentile and education



Source: Authors own analysis of EU-SILC data

Figure 9 Distribution of FWB latent factor scores by household type and stratum



Source: Authors own analysis of EU-SILC data

Table 1 Financial well-being score indicators		
Category	Indicator	Maximum Score
Income	Income_t: Total disposable household income	10
	Income_1: Lowest monthly income to make ends meet	10
Debts	Debt_1: Debt	10
	Debt_2: Arrears	10
	Debt_3: Ability to make ends meet	10
	Debt_4: Financial burdens	10
Savings	Saving_1: Can save some income regularly	10
	Saving_2: Capacity to face unexpected financial expenses	10
	Saving_3: Capacity to afford paying for one-week annual holiday away from home	10
Financial satisfaction	Financial satisfaction: Satisfaction with financial situation	10
Total Potential Score for Financial Well-being		100

Source: Irish SILC data 2020

Table 2 Cross-loading of each indicator				
	Financial Behaviours Factor1	Financial Satisfaction Factor2	Financial Difficulty Factor3	Minimum Income Factor4
Income_t	0.272		0.198	
Income_1	0.166	-0.126		0.773
Debt_1		0.669	-0.145	
Debt_2		-0.134	0.372	0.296
Debt_3	0.518	0.101		0.327
Debt_4	0.273		0.751	
Saving_1	0.354	0.388		
Saving_2	0.667		0.101	0.118
Saving_3	0.805			
Financial satisfaction	0.120	0.917		
SS loadings	1.683	1.500	0.819	0.779
Proportion Var	0.168	0.150	0.082	0.078
Cumulative Var	0.168	0.318	0.400	0.478
Test of the hypothesis that 4 factors are sufficient.				
The chi square statistic is 111.79 on 11 degrees of freedom.				
The p-value is 8.05e-19				

Source: Authors own analysis of EU-SILC data

Table 3 Path coefficients, t-statistics and CI of the PLS-SEM						
	Original Est.	Mean	SD	t-statistic	2.5% CI	97.5% CI
FB -> FWB	0.5664	0.5666	0.0034	168.7207	0.5602	0.573
FS -> FWB	0.6304	0.6303	0.0053	118.3437	0.6199	0.6407
FD -> FB	0.3863	0.3862	0.009	43.1465	0.3685	0.4035
FD -> FS	0.0647	0.065	0.0093	6.9429	0.0471	0.0839
FD -> FD	0.0344	0.0343	0.0041	8.3312	0.0265	0.0423
FD -> MI	0.1859	0.1856	0.0113	16.408	0.1633	0.2068
FD -> FT	0.0089	0.0093	0.0102	0.8765	-0.0098	0.0293
FD -> FWB	0.4707	0.4711	0.0081	58.3654	0.4557	0.4876
MI -> FB	0.0928	0.0925	0.0108	8.6331	0.0721	0.1145
MI -> FS	-0.2155	-0.215	0.0096	-22.3611	-0.2342	-0.1964
MI -> FD	0.189	0.1887	0.0115	16.3759	0.1666	0.2105
MI -> MI	0.0511	0.051	0.005	10.2601	0.041	0.0608
MI -> FT	-0.1331	-0.1334	0.0114	-11.6859	-0.1563	-0.1103
MI -> FWB	0.239	0.2389	0.0095	25.1145	0.2215	0.2581
FT -> FB	0.0903	0.0905	0.0106	8.5449	0.0695	0.1112
FT -> FS	0.8493	0.8495	0.0046	184.6819	0.8406	0.8584
FT -> FD	0.0088	0.0092	0.01	0.8766	-0.0096	0.029
FT -> MI	-0.1288	-0.1291	0.011	-11.7088	-0.1509	-0.1062
FT -> FT	0.0173	0.0175	0.0027	6.4546	0.0125	0.0229
FT -> FWB	0.4885	0.4882	0.0083	59.1844	0.4716	0.5037

Source: Authors own analysis of EU-SILC data

Table 4 Financial well-being scores summary					
Min.	1 st Qu.	Median	Mean	3 rd Qu.	Max.
11.00	44.00	58.00	56.33	70.00	99.00

Source: Authors own analysis of EU-SILC data

Table 5 Levene's Test and t-test by gender								
	Levene's Test for Equality of Variables		t-Test for Equality of Mean					
	F	p. value	t	Sample size	p. value	Mean difference	95% CI	
							Low	High
FWB	0.501	0.479	1.31	11128	0.191	0.0248	-0.0124	0.0619
FB	9.20	0.00243	-3.06	11128	2.25e- 3	-0.0579	-0.0951	-0.0208
FS	21.9	0.000003	7.21	11128	5.93e-13	-0.0579	0.0993	0.173
FD	1.52	0.218	-0.638	11128	0.524	-0.0121	-0.0493	0.0251
MI	0.00168	0.967	-1.15	11128	0.249	-0.0219	-0.0590	0.0153
FT	15.1	0.000105	10.5	11128	1.32e-25	0.198	0.161	0.235

Source: Authors Own analysis of EU-SILC data, patterns consistent with OECD findings

Table 6 Levene's Test and t-test by immigration								
	Levene's Test for Equality of Variables		t-Test for Equality of Mean					
	F	p. value	t	Sample size	p. value	Mean difference	95% CI	
							Low	High
FWB	3.93	0.0475	5.54	11128	3.07e- 8	0.131	0.0844	0.177
FB	7.84	0.00513	-3.21	11128	1.35e- 3	-0.0756	-0.122	-0.0294
FS	9.64	0.00191	13.3	11128	4.56e-40	0.311	0.266	0.357
FD	0.456	0.500	-6.30	11128	3.06e-10	-0.148	-0.195	-0.102
MI	6.73	0.00950	3.56	11128	3.72e- 4	0.0840	0.0378	0.130
FT	0.730	0.393	17.5	11128	1.93e-67	0.407	0.361	0.452

Source: Authors own analysis of EU-SILC data

Table 7 Levene's Test and t-test by stratum								
	Levene's Test for Equality of Variables		t-Test for Equality of Mean					
	F	p. value	t	Sample size	p. value	Mean difference	95% CI	
							Low	High
FWB	62.6	2.70e-1	-2.44	11128	0.0149	-0.0462	-0.0834	-0.0090
FB	22.3	2.41e- 6	-5.56	11128	2.69e- 8	-0.106	-0.143	-0.0683
FS	1.90	0.168	-3.05	11128	2.32e- 3	-0.0578	-0.0950	-0.0206
FD	29.3	6.41e- 8	-0.318	11128	0.750	-0.00604	-0.0433	0.0312
MI	1.60	0.206	8.71	11128	3.58e-18	0.165	0.128	0.202
FT	8.45	3.65e- 3	0.0639	11128	0.949	0.00121	-0.0360	0.0384

Source: Authors own analysis of EU-SILC data

Table 8 Levene's Test and t-test by income								
	Levene's Test for Equality of Variables		t-Test for Equality of Mean					
	F	p. value	t	Sample size	p. value	Mean difference	95% CI	
							Low	High
FWB	193.0	1.41e- 43	38.6	11128	3.29e-306	12.4	11.8	13.0
FB	193.0	1.41e- 43	38.6	11128	3.29e-306	0.687	0.653	0.722
FS	954.0	4.49e-201	37.1	11128	1.87e-284	0.664	0.629	0.699
FD	39.9	2.84e- 10	-11.1	11128	3.04e- 28	-0.208	-0.245	-0.171
MI	44.4	2.82e- 11	21.7	11128	1.08e-102	0.404	0.367	0.440
FT	160.0	2.25e- 36	44.4	11128	0	0.776	0.741	0.810

Source: Authors own analysis of EU-SILC data

Table 9 Levene's Test and t-test by income								
	Levene's Test for Equality of Variables		t-Test for Equality of Mean					
	F	p. value	t	Sample size	p. value	Mean difference	95% CI	
							Low	High
FWB	193.0	1.41e- 43	38.6	11128	3.29e-306	12.4	11.8	13.0
FB	193.0	1.41e- 43	38.6	11128	3.29e-306	0.687	0.653	0.722
FS	954.0	4.49e-201	37.1	11128	1.87e-284	0.664	0.629	0.699
FD	39.9	2.84e- 10	-11.1	11128	3.04e- 28	-0.208	-0.245	-0.171
MI	44.4	2.82e- 11	21.7	11128	1.08e-102	0.404	0.367	0.440
FT	160.0	2.25e- 36	44.4	11128	0	0.776	0.741	0.810

Source: Authors own analysis of EU-SILC data

Table 10 Evidence-based Behavioural Interventions

Policy Area	Behavioural Mechanisms	Implementation Approaches	Example Programs
Financial Education	Decision-making skills; Risk perception	School curriculum; integration; Adult financial literacy programs.	Ireland: Money Matters (CCPC) ¹ ; UK: Money and Pensions Service ² ; Australia: MoneySmart ³
Higher Education Access	Cognitive resource development	Income-contingent loans; Need-based grants; Vocational training.	Ireland: SUSI ⁴ ; UK: Student Finance ⁵ ; Germany: BAföG ⁶
Immigrant Financial Inclusion	System navigation behaviour; Information asymmetry reduction	Multilingual services; Cultural competency training; Targeted support.	Canada: Financial Literacy for Newcomers ⁷ ; Ireland: New Communities Partnership ⁸
Urban-Rural Balance	Geographic adaptation behaviours	Digital infrastructure; Location-adjusted supports.	EU Rural Development Programme ⁹ ; Australia: Regional Digital Connectivity ¹⁰
Income Support	Discretionary behaviour enablement	Progressive payments; Regional cost adjustment	Nordic flexible benefits ¹¹ ; Ireland: Working Family Payment ¹²
Non-standard Employment Protection	Precautionary behaviour support	Gig economy coverage; Specialised guidance.	EU Platform Work Directive ¹³ ; UK: Universal Credit Flexibility ¹⁴
Digital Financial Literacy	Technology engagement behaviours	Online learning platforms; Fintech integration.	Singapore: SkillsFuture Digital Workplace ¹⁵ ; EU: Digital Finance Platform ¹⁶
Integrated Policy Framework	Cross-domain behaviour coordination	Cross-departmental coordination; National strategies.	New Zealand Well-being Budget ¹⁷ ; Ireland: Well-being Framework ¹⁸

¹ [Money Tools - CCPC Consumers](#)

² <https://moneyandpensionsservice.org.uk/>

³ <https://moneysmart.gov.au/>

⁴ <https://susi.ie/>

⁵ <https://www.gov.uk/student-finance>

⁶ <https://www.bafög.de/>

⁷ <https://www.canada.ca/en/financial-consumer-agency/services/financial-literacy-newcomers.html>

⁸ <https://www.newcommunities.ie/>

⁹ https://agriculture.ec.europa.eu/common-agricultural-policy/rural-development_en

¹⁰ <https://www.infrastructure.gov.au/media-communications-arts/internet/regional-connectivity-program>

¹¹ <https://www.norden.org/en/info/nordic-welfare-systems>

¹² <https://www.gov.ie/en/service/working-family-payment/>

¹³ https://commission.europa.eu/law/platform-work_en

¹⁴ <https://www.gov.uk/universal-credit>

¹⁵ <https://www.skillsfuture.gov.sg/digitalworkplace>

¹⁶ <https://digital-finance-platform.ec.europa.eu/>

¹⁷ <https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework>

¹⁸ <https://www.gov.ie/en/publication/85b1e-well-being-framework/>

Table 11 Summary of Key findings and Implications

Category	Key Insights	Policy Implications
Behavioural Dimensions	Five dimensions: Financial Behaviours, Satisfaction, Difficulty, Minimum Income, Technology. Strong correlation ($r = 0.68$) between Financial Technology and Financial Behaviours highlights transformative digital impacts.	Integrate behavioural indicators into systemic risk monitoring dashboards. Use these indicators as early warning metrics for financial stability.
Demographic Vulnerability	Young adults (18-35): Present-focused decision-making increases vulnerability to shocks. Education buffers financial vulnerability, enabling effective behaviours even at lower income levels. Immigrants report higher Financial Difficulties ($t = -6.30$). Retired individuals display financial resilience across income levels.	Establish thresholds for demographic-specific financial vulnerabilities. Create education-focused financial literacy programs to strengthen financial behaviours. Address disparities in financial technology usage and access among immigrant populations. Tailor policies to leverage retirees' financial stability during downturns.
Technological Fragmentation Risk	Significant disparities in financial technology usage across income groups ($t = 44.4$), creating fragmentation risks. Emergence of shadow consumer credit complicates systemic risk monitoring.	Develop strategies to reduce technology adoption gaps and mitigate shadow consumer credit risks. Introduce measures for monitoring alternative lending platforms.
Methodology Contributions	Structural equation modelling identifies behavioural, cognitive, and technological components. Decomposition analysis highlights inequality distributions and transmission channels of systemic risks.	Implement frameworks that include behavioural insights into systemic risk analysis. Use this data to develop targeted interventions for at-risk populations.

Source: Authors own