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Research Article

The Squeezed Middle in Digital Financial Services: Ireland's Warning for European Consumer Protection Policy

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Abstract

This paper examines how digital financial services affect consumer welfare across income distributions using Ireland as a critical case study for European consumer protection policy. Our analysis of 11,128 Irish households from the 2020 EU Survey on Income and Living Conditions reveals that technology shows no direct association with consumer welfare (β=0.0022, p=0.969). Instead, it operates only through mediating channels that frequently fail for middle-income consumers. We identify a "squeezed middle" phenomenon where households between the 20th and 70th income percentiles experience persistent financial strain despite technology access. Young adults remain in negative financial well-being through the 70th income percentile despite 96.2 per cent technology access, suggesting structural barriers

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immigrants and natives. These findings from Ireland, where fintech adoption rates

reach 71 per cent compared to the European average of 64 per cent, challenge the European Union's €150 billion digital infrastructure investment introduced on automatic consumer benefits. We identify three mechanisms explaining this failure: capability mismatch where technological resources exceed user capabilities, economic constraints override where fundamental economic barriers overwhelm technology benefits, and satisfaction illusion where technology increases perceived control without improving objective outcomes. As Europe's most digitalised economy, Ireland provides an early warning for other member states pursuing similar strategies.

JEL Codes: D14, D18, G51, I31

Squeezed middle | Digital financial services | Consumer vulnerability | Financial well-being | Consumer protection | Ireland

Figures

1. Introduction

Consumer protection in digital financial markets presents a growing challenge across Europe as technology transforms how households manage their finances, yet the relationship between digital access and consumer welfare remains poorly understood. This paper uses Ireland as a critical test case to examine whether digital financial services actually improve consumer outcomes or merely create an illusion of progress that masks persistent vulnerability. We analyse both consumer vulnerability and producer responsibilities in digital markets, examining how market conduct and regulatory frameworks shape consumer outcomes in the Irish context.

We address three fundamental questions using Ireland's experience as an early

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intermediate mechanisms that may fail for certain population segments? Second, which demographic groups benefit from financial digitalisation and which experience increased vulnerability, providing evidence for targeted rather than universal policy approaches? Third, do digital financial services reduce or amplify existing inequalities in financial well-being, a question proving critical for social cohesion and consumer protection policy across Europe?

Ireland provides an ideal case for examining these questions, offering insights particularly relevant as other European countries pursue similar digitalisation strategies. As a small open economy with fintech adoption rates of 71 per cent compared to the EU average of 64 per cent, Ireland represents the future other European markets are pursuing through massive public investment (European Banking Authority, 2022). The country operates within the same regulatory framework as other EU member states, including PSD2 and GDPR, making findings directly relevant for understanding how EU-wide regulations interact with national contexts. Ireland's experience following the 2008 financial crisis, when household debt reached 218 per cent of disposable income and resulted in an EU-IMF bailout programme, offers additional insights into how consumer trust and technology adoption interact in post-crisis environments where financial institutions seek to rebuild relationships through digital channels (Honohan, 2010).

The significance of this research extends beyond Ireland's borders, though we acknowledge the focused nature of our single-country analysis. The European Union has committed €150 billion toward digital infrastructure through the Next Generation Recovery Fund, explicitly assuming that expanded digital access will automatically benefit consumers and reduce inequalities (European Commission, 2020). However, Ireland's experience raises fundamental questions about these assumptions that

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economic recovery (Competition and Consumer Protection Commission, 2023). If technology fails to improve consumer welfare in a highly digitalised, relatively prosperous economy like Ireland with strong institutions and high education levels, the challenges may prove even greater in countries with lower baseline digital literacy or weaker consumer protection frameworks.

This paper makes three distinct contributions to consumer policy literature that challenge prevailing assumptions about digital transformation. First, we provide evidence that technology has no direct effect on financial well-being, operating only through indirect mechanisms that frequently fail for vulnerable populations. This finding fundamentally questions the premise underlying major European digital infrastructure investments. Second, we identify and characterise the "squeezed middle" phenomenon, households between the 20th and 70th income percentiles who experience no benefit from technology despite access, revealing a previously hidden form of digital vulnerability affecting a substantial portion of the population. Third, we propose three mechanisms explaining why digital finance fails to deliver promised benefits: capability mismatch where technological resources exceed consumer capabilities to utilise them effectively, economic mechanisms where underlying economic constraints overwhelm any potential technology benefits, and satisfaction illusion where technology increases perceived control without improving objective outcomes.

2. Theoretical Framework and Literature Review

2.1 Reconceptualising Consumer Vulnerability for Digital Markets

Traditional approaches to consumer vulnerability focused on identifying fixed demographic characteristics such as age, income, or education level that placed

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frameworks struggle to capture. Baker et al. (2005) established that vulnerability should be understood as a state rather than a trait, emphasising that market conditions can create vulnerability for any consumer regardless of their individual characteristics. This reconceptualisation proves particularly relevant for digital markets where rapid technological change, complex interfaces, and opaque algorithmic decision-making can disadvantage even well-educated, financially literate consumers who may lack specific digital competencies or face temporary life circumstances that impair their decision-making capacity.

Digital markets create what Helberger et al. (2022) term "architectural vulnerability" through three interconnected mechanisms that operate differently from traditional market disadvantages. First, interface design shapes consumer choices through default settings, information presentation, and friction manipulation that consumers rarely recognise or can counteract even when aware. Digital lending platforms may display monthly payments prominently while total interest costs remain buried in supplementary screens, exploiting consumers' tendency to focus on salient information. Second, companies collect and analyse consumer data to identify and potentially exploit individual vulnerabilities, targeting payday loan advertisements to consumers whose transaction patterns suggest financial stress. Third, algorithmic decision-making systems may systematically disadvantage certain groups through feedback loops that reinforce existing inequalities, with credit scoring algorithms penalising characteristics correlated with immigration status or postal codes associated with social housing.

The capability approach developed by Amartya Sen (1999) provides a theoretical framework for understanding why technology access alone may not improve consumer welfare, distinguishing between resources (what people have), capabilities

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represents a resource, but converting this resource into improved financial management requires multiple capabilities including digital literacy, financial knowledge, confidence in navigating digital interfaces, and trust in digital service providers. Without these conversion factors, technology access may provide no benefit and could even harm consumers by exposing them to new risks they cannot manage effectively. This theoretical insight suggests that policy approaches focusing solely on expanding digital access without addressing capability development may fail to improve consumer outcomes and could potentially worsen inequalities by advantaging those with existing capabilities while leaving others behind.

2.2 Empirical Evidence on Digital Financial Services and Consumer Outcomes

Empirical research increasingly challenges optimistic assumptions about technology's effects on consumer financial welfare, revealing complex and often contradictory patterns that vary across demographic groups and institutional contexts. Carbó-Valverde et al. (2020) conducted a comprehensive analysis of 68,000 Spanish banking customers over five years, finding that those who adopted digital banking channels did so primarily for convenience rather than to improve their financial situation. Despite having access to real-time balance information, spending analytics, and automated savings tools, digital banking users showed no improvement in savings rates, debt management practices, or financial resilience compared to customers using traditional branch-based banking. This finding suggests that information and tools alone do not change behaviour without corresponding motivation and capability to use them effectively.

The behavioural economics literature provides explanations for why increased information and reduced transaction costs may surprisingly harm rather than help vulnerable consumers. Van der Cruijsen et al. (2023) found that the introduction of

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cent without any corresponding increase in financial satisfaction, suggesting that

reducing friction in payment processes may undermine self-control mechanisms that previously protected consumers from overspending. The "pain of paying" that physical cash transactions involve serves as a natural brake on spending that digital payments remove (Prelec & Loewenstein, 1998). Similarly, French et al. (2020) studied 15,000 UK consumers using smartphone financial apps, finding that 67 per cent of users reported feeling more informed about their finances, yet only 18 per cent demonstrated measurable improvement in financial behaviours after six months of app usage. This gap between perceived and actual improvement suggests technology may create dangerous overconfidence where consumers believe they manage money better simply because they have access to financial apps while their objective financial situations deteriorate.

The economics of information, pioneered by Joseph Stiglitz (2000), helps explain why more information does not automatically improve consumer decision-making in digital financial markets. Information proves valuable only if consumers can process it effectively and act upon it, yet digital financial services often overwhelm consumers with data while obscuring crucial terms through complex interfaces and legal jargon. Furthermore, what Hanson and Kysar (1999) term "market manipulation through bounded rationality" becomes easier in digital environments where companies can conduct rapid A/B testing to identify and exploit cognitive biases at scale (Luguri & Strahilevitz, 2021). Digital lenders can test thousands of interface variations to identify presentations that maximise loan uptake regardless of borrower welfare, representing systematic exploitation impossible in traditional face-to-face banking relationships where regulatory oversight and reputational concerns provide some consumer protection.

2.3 Regulatory Context and Producer Conduct

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consumer protection frameworks struggle to address, with different jurisdictions

adopting varied approaches reflecting different philosophical positions on the balance between innovation and protection. The European Union's regulatory approach, embodied in the revised Payment Services Directive (PSD2) and the Digital Finance Strategy, emphasises market competition and innovation while assuming consumer benefit follows automatically from increased choice and reduced costs (European Parliament, 2015; European Commission, 2020). This assumption underlies policies promoting open banking where banks must share customer data with third-party providers upon customer request, theoretically enabling consumers to access better services. However, evidence from early-adopting countries suggests limited consumer uptake and understanding of open banking, with only 9 per cent of UK consumers using open banking services three years after implementation despite significant promotional efforts (Financial Conduct Authority, 2021).

The regulatory landscape from 2023–2025 demonstrates a fundamental shift in European consumer protection philosophy, recognising that technology creates novel consumer risks requiring purpose-built protections rather than adapted analogue regulations. The Markets in Crypto-Assets Regulation (MiCA) (European Securities and Markets Authority, 2024), established mandatory fund segregation, white paper disclosures, and dispute resolution mechanisms that directly address the capability mismatch our study identifies. The 2025 Digital Operational Resilience Act (DORA) requires comprehensive ICT risk management frameworks to ensure service continuity during cyber incidents that previously left vulnerable consumers without access to funds (BaFin, 2024). The AI Act's financial services provisions, taking effect in August 2026, classify creditworthiness evaluation and insurance risk assessment as high-risk AI applications requiring human oversight, bias testing, and

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from regulatory sandbox experiments suggests mixed results. While Cornelli et al.

(2024) found that UK sandbox participation increased fintech funding by 15 per cent questions remain about whether innovation-focused regulation adequately protects vulnerable consumers. While Ireland operates under EU frameworks, implementation varies significantly. Germany's BaFin takes a more prescriptive approach to digital finance oversight, while the Netherlands' AFM emphasizes behavioural supervision. These variations affect how the three mechanisms manifest across jurisdictions.

2.4 Three Potential Mechanisms from Theory

Drawing on Sen's capability approach and the empirical evidence reviewed above, we propose three potential mechanisms that may explain why technology access fails to improve consumer welfare in the Irish context. First, "capability mismatch" may occur when technological resources exceed consumer capabilities to utilise them effectively, creating a gap between what technology offers and what consumers can actually achieve with it (Sweller, 1988). Second, "economic constraints override" potentially describes how underlying economic constraints such as housing costs, employment precarity, and debt burdens overwhelm any potential technology benefits, rendering technological solutions irrelevant to fundamental economic challenges (Mani et al., 2013). Third, "satisfaction illusion" might emerge when technology increases perceived control without improving objective outcomes, creating false confidence that prevents consumers from recognising their deteriorating financial situations (Davis, 1989). These mechanisms, if confirmed in our analysis, would extend existing vulnerability theories by explicitly linking technological, psychological, and structural factors in creating digital-specific consumer vulnerability.

3. Data and Methodology

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Our analysis utilises Ireland's 2020 implementation of the European Union Survey on Income and Living Conditions (EU-SILC), a harmonised instrument that enables cross-national comparison while capturing country-specific patterns relevant to consumer protection policy. The EU-SILC represents the European Union's primary tool for monitoring income, poverty, and social exclusion, with standardised methodology ensuring comparability across member states while allowing national statistical offices to include additional modules addressing specific policy priorities. Ireland's Central Statistics Office conducted the 2020 survey between January and June 2020 with income reference periods covering 2019, capturing financial behaviours before pandemic-induced digitalisation that might confound the relationship between voluntary technology adoption and consumer outcomes.

The survey employs a sophisticated stratified random sampling design ensuring representativeness across geographic and demographic dimensions critical for understanding differential vulnerability patterns in digital financial services. After excluding observations with missing data on key financial well-being and technology access variables, our analytical sample comprises 11,128 households, representing 89.2 per cent retention from the original sample of 12,481 households surveyed. This high retention rate suggests limited systematic bias from missing data, though we acknowledge that the most vulnerable households may be underrepresented if they were less likely to complete complex financial questions.

Table 1 shows how the EU-SILC framework ensures comparability while acknowledging measurement variations across jurisdictions, proving critical for interpreting our findings in broader European contexts. The harmonisation process follows Eurostat's comprehensive technical guidelines for EU-SILC target variables and data collection procedures (Eurostat, 2022), revealing important considerations

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Insert Table 1 here

3.2 Constructing a Multidimensional Measure of Financial Well-being

Following theoretical frameworks establishing financial well-being as multidimensional, we construct a comprehensive measure incorporating ten indicators across four conceptual domains that capture different aspects of households' financial lives rather than reducing them to single metrics like income or wealth. This approach extends the validated European framework developed by Kempson and Poppe (2018) for the Norwegian government and subsequently adopted by consumer protection agencies across Europe, incorporating insights from Netemeyer et al. (2018) on the importance of subjective well-being components that may diverge from objective financial circumstances. Our measurement strategy recognises that financial well-being encompasses current financial resources, security about the future, freedom to make choices, and the psychological burden of financial management, each of which digital financial services may affect differently.

Table 2 presents descriptive statistics for our financial well-being indicators, revealing substantial variation across different dimensions that suggests they capture distinct aspects of financial life rather than simply reflecting overall economic resources. The patterns in these statistics tell an important story about financial vulnerability in Ireland that likely resonates across Europe.

Insert Table 2 here

The variation in means across indicators reveals important patterns about the nature of financial vulnerability. Savings indicators show the lowest means (3.45-5.60) with the highest standard deviations (4.12-4.62), suggesting that building financial buffers represents the most constrained dimension of financial well-being with the greatest

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problems and payment arrears, yet they struggle to accumulate resources for future

security or discretionary spending. Technology might alleviate this through automated savings tools, or alternatively might exacerbate it through frictionless spending mechanisms. The relatively high mean for avoiding arrears (8.75) combined with the low mean for regular saving (3.45) suggests households prioritise meeting immediate obligations over building long-term security, representing a rational response to precarity that technology cannot address without underlying economic stability.

3.3 Analytical Methods

Our analytical approach employs three complementary methods that together reveal how technology relates to financial well-being across different population segments. First, we use exploratory factor analysis to identify underlying dimensions of financial well-being, finding patterns in how different indicators cluster together to understand whether financial well-being represents a single concept or comprises distinct components such as behavioural capacity versus subjective satisfaction that could respond differently to technology adoption. Second, we employ structural equation modelling, specifically partial least squares (PLS-SEM), to test whether technology directly affects financial well-being or works through intermediate pathways, allowing us to trace complex relationships and determine whether technology must first influence behaviours or satisfaction before affecting overall well-being. Third, we conduct detailed demographic comparisons using appropriate statistical tests that account for the fact that variation within groups often differs across demographic categories, ensuring our findings reflect genuine differences rather than statistical artefacts.

The factor analysis employs principal component analysis with varimax rotation to identify the minimum number of underlying dimensions needed to explain patterns in our ten indicators while making these dimensions as distinct and interpretable as

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that we label Financial Behaviours (capturing saving and spending patterns), Financial

Satisfaction (reflecting subjective evaluation), Financial Difficulty (measuring constraint and stress), and Minimum Income (assessing perceived needs). We add a fifth dimension, Financial Technology, based on theoretical considerations about digital access becoming increasingly central to financial participation. The Kaiser-Meyer-Olkin measure of 0.832 and Bartlett's test (χ^2=27,251.8, p<0.001) confirm that our data suit factor analysis, with these technical validations meaning the patterns we identify are statistically robust rather than random noise.

3.4 Robustness and Model Validation

To ensure the reliability of our PLS-SEM findings, we conducted several robustness checks following established methodological guidelines for structural equation modelling with survey data. The Kaiser-Meyer-Olkin measure of sampling adequacy yielded 0.832, substantially exceeding the recommended threshold of 0.6 and confirming our data's suitability for factor analysis. Bartlett's test of sphericity (χ^2=27,251.8, p<0.001) rejected the null hypothesis that the correlation matrix is an identity matrix, further validating the factorability of our variables.

Our factor analysis hypothesis testing confirmed that four factors suffice for the financial well-being model (χ^2=111.79, df=11, p=8.05e-19), indicating significant improvement over a three-factor solution while a fifth factor would not substantially improve model fit. The cumulative variance explained by our four-factor solution reaches 47.8 per cent with individual factors explaining between 7.8 and 16.8 per cent of variance, demonstrating reasonable coverage of the underlying construct space without overfitting.

Path coefficient confidence intervals from our PLS-SEM bootstrap procedure with 5,000 resamples demonstrate statistical precision in our estimates. The direct path

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direct effect. In contrast, the mediated pathways show substantial and statistically significant coefficients with non-overlapping confidence intervals, supporting our interpretation of technology operating exclusively through intermediate mechanisms.

4. Empirical Findings

4.1 The Distribution and Structure of Financial Well-being in Ireland

Our analysis begins by examining how financial well-being distributes across the Irish population, revealing patterns that likely resonate across Europe given similar economic structures and challenges. Table 3 presents distribution statistics demonstrating substantial heterogeneity in financial well-being, with scores ranging from severe deprivation (minimum 11.00) to high prosperity (maximum 99.00) on our 100-point scale. The negative skewness of -0.41 indicates a concentration of households with below-average scores pulling the distribution leftward, suggesting that financial vulnerability affects a substantial minority rather than isolated cases, a pattern appearing consistent with other European countries experiencing similar housing affordability crises and labour market precarity.

Insert Table 3 here

The percentile distribution reveals concerning patterns about financial vulnerability in a relatively prosperous European economy. The 26-point gap between the 10th percentile (32.00) and median (58.00) substantially exceeds the 19-point gap between median and 90th percentile (77.00), indicating that vulnerability concentrates in the lower tail of the distribution rather than spreading evenly across the population. This asymmetric distribution suggests that universal interventions may prove less effective than targeted approaches addressing specific vulnerability

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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 Van 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. Such demographic clustering creates potentially pronounced contagion channels during financial stress periods. As Mian and Sufi (2018) demonstrated, when individual-level behaviours become correlated across demographic segments, systemic risks develop through coordinated deleveraging, creating system-wide instability through behavioural transmission mechanisms.

Figure 1[1] illustrates the distribution of financial well-being scores across age groups and gender, revealing a clear life-cycle pattern where financial well-being improves with age, peaking among those approaching retirement. However, a pronounced gender gap persists across all age cohorts, with women consistently reporting lower financial well-being scores than men, the gap widening in middle age. This pattern aligns with OECD findings on gender-based economic disparities and provides visual confirmation of the structural disadvantages women face throughout their financial lives.

Insert Figure 1 here

Factor analysis reveals that financial well-being comprises distinct dimensions rather than a unitary construct, with critical implications for understanding how technology might affect different aspects of financial life differently. Table 4 presents factor

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Insert Table 4 here

The factor structure reveals important insights about the nature of financial well-being that technology might influence through different pathways. Financial Behaviours emerges as the primary dimension explaining 16.8 per cent of variance, showing strongest loadings on discretionary spending capacity such as affording holidays (0.805) and managing unexpected expenses (0.667). This dimension captures active financial management capabilities rather than passive resource availability, suggesting that interventions improving behavioural capacity might prove more effective than simple income transfers. Financial Satisfaction represents a distinct evaluative dimension explaining 15.0 per cent of variance, dominated by subjective assessment (0.917) with secondary contribution from avoiding debt for ordinary expenses (0.669). As Joo and Grable (2004) demonstrate, this subjective evaluation fundamentally shapes subsequent financial behaviour independently of objective economic circumstances, potentially serving as an early warning indicator of changing behaviours that could create systemic vulnerabilities. The separation between behavioural capacity and satisfaction proves crucial for understanding how technology might increase satisfaction through information provision and perceived control without actually improving objective financial behaviours or outcomes.

4.2 Technology's Lack of Direct Effects on Financial Well-being

The most striking finding from our structural equation modelling is that technology shows no direct effect on financial well-being, fundamentally challenging assumptions underlying digital inclusion policies across Europe. Table 5 presents path coefficients from our PLS-SEM analysis revealing the complete absence of any direct relationship between technology access and financial well-being.

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The direct path from Financial Technology to Financial Well-Being is essentially zero (β=0.0022) and statistically insignificant (p=0.969). This null finding is not marginal or borderline but represents a clear absence of any direct relationship, demonstrating that simply providing technology access offers no inherent benefit for consumer financial welfare. However, technology does show strong associations with intermediate dimensions of financial well-being, particularly affecting Financial Satisfaction (β=0.668) and Financial Behaviours (β=0.646), suggesting that technology operates through indirect pathways rather than providing direct benefits.

The total indirect effect of technology on financial well-being equals 6.05, calculated as the sum of technology's effect through each mediating pathway. Financial Behaviours contributes 2.77 (0.646 × 4.29), Financial Satisfaction contributes 1.97 (0.668 × 2.95), reduced Financial Difficulty contributes 1.13 (-0.421 × -2.69), and Minimum Income effects contribute 0.18 (-0.133 × -1.36). This decomposition reveals that technology primarily influences welfare through psychological and behavioural channels, accounting for 78.4 per cent of total indirect effect, rather than directly alleviating financial constraints or increasing resources. This pattern aligns with Aikman et al. (2019) who demonstrate that behavioural indicators often outperform standard metrics in early warning systems, suggesting that these psychological channels may be more important for understanding vulnerability than traditional economic measures.

Figure 2 demonstrates the interaction between income and age in determining financial well-being, clearly showing that young adults require substantially higher income percentiles to achieve equivalent financial well-being compared to older cohorts. Notably, young adults remain in negative territory through the 70th income percentile, while older adults achieve positive well-being from the 40th percentile

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where middle-income households—particularly younger ones—experience persistent financial strain despite reasonable earnings.

Insert Figure 2 here

4.3 Demographic Variations in Technology-Welfare Relationships

Our analysis reveals pronounced demographic variations in how technology relates to financial well-being, with certain groups experiencing systematic disadvantage despite or even because of technology adoption. Table 6[2] presents gender differences revealing a complex pattern that challenges assumptions about digital equality.

Insert Table 6 here

Women demonstrate superior Financial Behaviours ($t=-3.06$, $p<0.01$) yet report significantly lower Financial Satisfaction ($t=7.21$, $p<0.001$) and Technology usage ($t=10.5$, $p<0.001$). This paradox of better financial management combined with lower satisfaction and technology engagement suggests structural disadvantages that superior behavioural competence cannot overcome. Three factors may explain this paradox in the Irish context, each requiring investigation in other European markets. First, algorithmic bias in credit scoring and product offerings may systematically disadvantage women despite their demonstrably better financial behaviours. Second, digital financial services often assume primary account holder models that fail to accommodate complex household financial arrangements where women manage finances but lack formal account control. Third, the technology gap we observe may reflect rational avoidance of digital channels that fail to serve women's needs, representing informed choice rather than capability deficits. Financial institutions may inadvertently encourage these disparities through product design and marketing indicators overlook.

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Figure 3 reveals the complex relationship between education and gender in shaping financial well-being. While education provides a consistent buffer effect—with each educational level showing approximately 5-7 points higher well-being—the gender gap persists across all educational categories. Even highly educated women report lower financial well-being than men with equivalent qualifications, suggesting that education alone cannot overcome the structural disadvantages women face in financial markets.

Insert Figure 3 here

Immigration status creates even more pronounced disparities across all dimensions of financial well-being, with implications for increasingly diverse European societies. Table 7 reveals the magnitude of these disparities.

Insert Table 7 here

Immigrants face a 40.7 per cent technology gap compared to natives ($t=17.5$, $p<0.001$), representing the largest disparity we observe across any demographic comparison. Yet despite this substantial technology gap, technology access fails to explain the welfare differences between immigrants and natives. Immigrants with technology still show persistent satisfaction deficits and elevated financial difficulties, suggesting that institutional and cultural barriers dominate technological considerations in determining immigrant financial welfare. This technological fragmentation creates what Adrian and Liang (2018) describe as monitoring challenges for existing consumer protection frameworks, as traditional metrics capture only 62% of household financial vulnerabilities when technological engagement varies significantly across population segments.

Figure 4 demonstrates how education moderates the relationship between income

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curve upward, with tertiary-educated households achieving positive well-being at

lower income percentiles than those with primary education only. However, the parallel nature of these curves indicates that education provides a consistent advantage rather than changing the fundamental income-well-being relationship.

Insert Figure 4 here

Figure 5 starkly illustrates the compound disadvantages faced by immigrants across all employment categories. Native-born workers consistently achieve higher financial well-being scores than immigrants in equivalent employment situations. The gap proves particularly pronounced among the unemployed, where immigrants face double jeopardy of both employment and immigration-related barriers.

Insert Figure 5 here

4.4 The Squeezed Middle and Income-Technology Interactions

Perhaps our most policy-relevant finding concerns the "squeezed middle" phenomenon where households between the 20th and 70th income percentiles show limited improvement in financial well-being despite technology access. This 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. We first examine urban-rural differences (Table 8) to understand spatial variations before analysing income-based disparities.

Insert Table 8 here

Table 8 reveals that rural households achieve significantly better financial well-being (FWB) than urban households ($t=-2.44$, $p=0.0149$) despite no significant difference in technology access (FT: $t=0.0639$, $p=0.949$). Rural residents demonstrate superior

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pattern challenges assumptions that digital access necessarily improves welfare, suggesting that rural communities may have developed effective non-digital financial management strategies that technology cannot improve upon. Table 9 on the other and demonstrates the dramatic disparities between income groups across all dimensions of financial well-being.

Insert Table 9 here

The technology gap of 77.6 per cent (mean difference = 0.776) represents the strongest stratification we observe, with a t-statistic of 44.4 indicating massive differences in technology access between income groups. Yet this difference in technology access fails to translate into proportional welfare improvements for lower-income households. While technology shows the largest gap, the Financial Well-Being difference (mean difference = 12.4) remains substantial but not proportional to the technology divide, suggesting that capability constraints and structural economic factors prevent technology from addressing fundamental economic disadvantages.

The high F-statistics in Levene's tests across multiple components, particularly for Financial Satisfaction (F=954.0) and Financial Well-Being (F=193.0), indicate substantial variance heterogeneity between income groups. This heterogeneity means not only that average outcomes differ but also that the distribution and predictability of outcomes varies dramatically by income level. Universal policy approaches will therefore affect income groups differently, with interventions that help higher-income households potentially having no effect or even negative effects for lower-income households who face different constraints and challenges.

Figure 6 reveals how employment status shapes the income-well-being relationship. Employed individuals show a steeper positive slope, indicating that additional income

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suggesting that income support alone—without addressing employment precarity—provides limited well-being benefits.

Insert Figure 6 here

Figure 7 provides an alternative visualisation of the age-income interaction, clearly delineating how financial well-being trajectories differ across the life course. The diverging lines demonstrate that age provides increasing advantages at higher income levels while offering little benefit at lower income percentiles.

Insert Figure 7 here

Figure 8 offers additional perspective on the education-income nexus, confirming that while education consistently improves financial well-being, its benefits concentrate among higher-income households. The converging lines at lower income levels indicate that education provides minimal protection against financial hardship when income remains inadequate.

Insert Figure 8 here

Figure 9 demonstrates rural-urban differences in the technology-well-being relationship. Rural households achieve superior financial well-being despite lower technology adoption, suggesting that forcing digital adoption may harm consumers who have developed effective non-digital financial management strategies.

Insert Figure 9 here

[1] All figures display financial well-being (FWB) scores derived from PLS-SEM analysis, measured on a 0-100 scale where higher scores indicate better financial well-being. N=11,128 households from Ireland's 2020 EU-SILC implementation.

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5. Discussion and Policy Implications

5.1 Ireland as Europe's Early Warning System

Our findings from Ireland offer critical lessons for consumer protection policy across Europe, serving as an early warning from Europe's most digitalised economy rather than universal truths. The complete absence of direct technology effects on financial well-being (β=0.0022, p=0.969) in Ireland fundamentally challenges assumptions underlying the European Union's €150 billion digital infrastructure investment. If technology fails to directly improve consumer welfare in a relatively prosperous, highly educated, digitally advanced economy like Ireland, the challenges may prove even greater in countries with lower baseline digital literacy, weaker consumer protection frameworks, or greater economic inequality.

The European Commission's Digital Finance Strategy explicitly assumes that expanded digital access will "bring additional benefits to consumers" and "ensure that EU consumers and businesses reap the benefits of digital finance" (European Commission, 2020). Our evidence from Ireland demonstrates these benefits do not materialise automatically but require specific conditions including consumer capabilities, institutional support, and addressing structural economic barriers that technology alone cannot overcome. The dominance of psychological pathways in technology's influence raises concerns about evaluation frameworks across Europe. Satisfaction effects (32.6 per cent) prove nearly as strong as behavioural effects (45.8 per cent), suggesting that if technology primarily makes consumers feel better about their financial situation without generating objective improvements, evaluation frameworks relying on satisfaction surveys may systematically overstate benefits while missing continuing vulnerability. Evidence suggests these vulnerabilities can have

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crises, showing behavioural indicators outperform standard credit-to-GDP measures in early warning systems.

Recent enforcement actions across Europe validate the patterns we identify in Ireland. The UK FCA fined Starling Bank £29 million[3] for sanctions screening failures during rapid growth. This demonstrates how the capability mismatch manifests operationally when automated screening covered only UK-linked sanctions entries while the bank opened 54,000 accounts[4] for high-risk customers despite regulatory restrictions (FCA, 2024). TSB Bank received a £48.65[5] million fine for IT migration failures affecting 5.2 million customers, with elderly customers without digital alternatives facing complete banking access loss. This provides empirical evidence of the economic constraints override. Metro Bank's £16.7 million penalty for leaving 60 million transactions worth £51 billion[6] unmonitored demonstrates how technical system failures disproportionately affect vulnerable consumers who cannot identify or report suspicious activities themselves.

5.2 The Three Mechanisms Explaining Digital Finance Failure

Our identification of three mechanisms, capability mismatch, economic constraints override, and satisfaction illusion, provides a framework for understanding why digital finance fails to deliver promised benefits in the Irish context, with implications for producer conduct and regulatory responses across Europe.

The capability mismatch mechanism manifests when technological resources exceed consumer capabilities to utilise them effectively. This appears particularly acute for the 40.7 per cent of immigrants facing technology gaps but extends beyond simple access issues to encompass the complex relationship between digital literacy, financial knowledge, and system navigation skills. Financial service providers may

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cannot understand or challenge, and product features that require sophisticated understanding to use effectively. The persistence of this mismatch despite Ireland's high education levels suggests that traditional financial literacy approaches prove insufficient for digital contexts.

The Economic constraints override mechanism explains why underlying economic constraints overwhelm any potential technology benefits. Young adults remaining in negative financial well-being through the 70th income percentile despite 96.2 per cent technology access demonstrates that structural barriers cannot be addressed through technological solutions. Housing costs consuming excessive income shares, employment precarity affecting even moderate earners, and debt burdens that algorithmic credit scoring may exacerbate rather than alleviate represent fundamental challenges that technology cannot solve. This mechanism suggests that producer strategies focusing on digital solutions while ignoring structural constraints may actually worsen consumer outcomes by creating additional costs and complexity without addressing core problems.

The satisfaction illusion mechanism proves perhaps most concerning from a consumer protection perspective, as technology increases perceived control without improving objective outcomes. Our decomposition showing satisfaction effects accounting for 32.6 per cent of technology's indirect influence while behavioural effects account for 45.8 per cent reveals that nearly a third of technology's impact operates through psychological rather than material channels. This mechanism aligns with Joo and Grable's (2004) framework showing how subjective financial satisfaction shapes subsequent financial behaviour independently of objective circumstances, potentially serving as an early warning indicator of changing behaviours that could create broader vulnerabilities. Financial Satisfaction's loading of 0.917 reflects

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could create systemic vulnerabilities. Financial service providers may exploit this mechanism through design choices that maximise engagement metrics and satisfaction scores while obscuring objective welfare deterioration. Features such as spending categorisation, balance alerts, and financial dashboards may make consumers feel more in control while their actual financial situations worsen through increased spending facilitated by frictionless payments or poor investment decisions enabled by gamified trading platforms.

5.3 Implications for Producer Conduct and Market Innovation

Financial institutions operating across European markets can learn lessons from patterns observed in Ireland regarding which consumer segments benefit from digital services versus those who may be harmed or excluded. Our findings suggest that current industry approaches often miss or exploit the vulnerabilities we identify rather than addressing genuine consumer needs.

The squeezed middle represents a substantial market segment requiring tailored approaches rather than one-size-fits-all digital solutions. Current industry practices of rapid digital migration, branch closures, and self-service emphasis may harm this segment by removing support structures they rely upon while providing digital tools they cannot use effectively. Providers who develop capability-building features integrated into service delivery, maintain non-digital alternatives for complex transactions, and focus on objective welfare improvements rather than engagement metrics, may achieve better long-term customer relationships and regulatory compliance.

The gender paradox we identify, where women demonstrate superior financial behaviours but lower satisfaction and technology usage, suggests that gender-

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management, and algorithms tested for gender bias could better serve women's needs. Similarly, the immigration technology gap demands culturally adapted financial products that go beyond simple translation to address institutional unfamiliarity and trust deficits. Financial institutions may inadvertently encourage these disparities through product design and marketing strategies, creating a systemic market failure that traditional consumer protection indicators overlook. As Mian and Sufi (2018) demonstrate, these household-level vulnerabilities can amplify into system-wide instability through coordinated behavioural responses during economic stress. Table 10 provides specific producer conduct implications from our findings, showing how current industry approaches create market failures and identifying evidence-based innovations that have successfully addressed similar vulnerabilities.

Insert Table 10 here

5.4 Policy Recommendations for Ireland and Europe

Based on our analysis of 11,128 Irish households, we identify critical interventions needed at multiple policy levels. We propose a three-phase approach to address the vulnerabilities we identify. The Detection Phase requires establishing behavioural monitoring dashboards with quarterly tracking across our five dimensions, with thresholds based on relative measures of statistical variance. The Prevention Phase implements graduated intervention policies triggered by threshold breaches, including mandatory cooling-off periods for credit applications from vulnerable groups. The Mitigation Phase deploys differentiated response strategies based on behavioural segments during crisis periods.

For Irish policymakers specifically, three reforms appear essential. First, mandatory capability assessments before complex digital product access would address the

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Second, preservation of non-digital channels remains vital as rural residents achieve superior well-being despite lower technology use, validating the need for maintaining traditional banking services alongside digital offerings. Third, regulatory frameworks must move beyond disclosure-based approaches to address the satisfaction illusion, requiring firms to demonstrate actual welfare improvements rather than merely increased engagement or satisfaction scores.

For European policymakers more broadly, our Irish evidence raises fundamental questions requiring urgent investigation. The squeezed middle phenomenon we identify between the 20th and 70th percentiles may manifest at different thresholds in countries with varying welfare systems, but the underlying pattern of middle-income vulnerability likely exists across Europe. National implementations of EU directives and variations in enforcement intensity will affect how the capability mismatch mechanism operates across jurisdictions. The strength of the satisfaction illusion effect may vary with national financial cultures and consumer protection traditions. Table 11 synthesises our findings with current European policy approaches to identify specific lessons for designing consumer protection frameworks.

Insert Table 11 here

These findings demonstrate that both regulatory intervention and market innovation are needed to address the three mechanisms we identify. The capability mismatch requires mandatory assessment and support structures, the economic constraints override demands fundamental economic reforms beyond digital solutions, and the satisfaction illusion necessitates outcome-based rather than engagement-based metrics for both regulatory compliance and business success. While our analysis focuses on Ireland as a critical case study, the patterns we observe likely resonate

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5.5 Limitations and Future Research Directions

While our study provides important insights into digital finance and consumer welfare, several limitations should be acknowledged that point toward productive future research directions. The cross-sectional nature of our dataset represents a key limitation, as it cannot capture the dynamic evolution of financial behaviours during stress periods. Longitudinal analysis using panel data would strengthen causal inference, allowing researchers to track how technology adoption affects individual households over time and identify whether initial benefits decay or accumulate.

Our single-country focus on Ireland enables deep analysis of mechanisms but limits generalisability to other European contexts. Ireland's unique characteristics, small open economy, English language, high digitalisation, post-crisis environment, may not represent larger, more diverse, or less digitalised European countries. while similar patterns emerge in other countries, contextual factors such as welfare system generosity, regulatory enforcement intensity, and baseline digital infrastructure affect how these mechanisms manifest. Future research should test whether the three mechanisms we identify operate similarly in different institutional contexts, particularly comparing common law and civil law jurisdictions, countries with different welfare state models, and economies at different stages of digital transformation. The cross-sectional nature of our data captures associations but cannot establish causality. While using pre-pandemic 2019 data avoids confounding from forced digitalisation during COVID-19, we cannot determine whether technology adoption causes the patterns we observe or whether underlying characteristics drive both technology use and financial outcomes. Longitudinal analysis using panel data would strengthen causal inference, allowing researchers to track how technology adoption affects individual households over time and identify whether initial benefits decay or

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Our measurement of technology access rather than usage intensity provides important insights about whether mere access improves welfare but may understate technology's potential benefits for intensive users. Future research should examine usage patterns, feature adoption, and skill development to understand whether more sophisticated technology use yields different outcomes. However, our finding that even access shows no direct benefit suggests that more nuanced usage measures would likely reveal even weaker relationships, as demonstrated by Carton et al. (2022a) who found 94 per cent technology access but only 31 per cent financial management usage among Irish social housing residents.

The EU-SILC dataset, while comprehensive and standardised across Europe, lacks certain variables that would enrich analysis. Detailed information on specific financial products used, digital skill levels, financial literacy scores, and experience with financial difficulties would enable more precise identification of vulnerability mechanisms. Future research combining survey data with administrative records or experimental methods could provide deeper insights into how consumers actually interact with digital financial services.

Our focus on consumer outcomes does not directly observe producer behaviour, limiting our ability to definitively establish whether firms deliberately exploit the mechanisms we identify. Research combining consumer data with firm-level information on product design choices, marketing strategies, and business models would better establish the role of producer conduct in creating or alleviating digital vulnerability. Mystery shopping studies, field experiments, and analysis of A/B testing data could reveal how firms optimise for engagement versus welfare. Finally, our pre-pandemic data cannot address how COVID-19's forced digitalisation affected the patterns we identify. The pandemic may have accelerated capability development for

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should examine whether forced adoption differs from voluntary adoption in its welfare effects and whether pandemic-era digital habits persist or revert.

[3] FCA fines Starling Bank £29m for failings in their financial crime systems and controls | FCA

[4] Final Notice 2024: Starling Bank Limited

[5] TSB fined £48.65m for operational resilience failings | FCA

[6] Enforcement watch: FCA fines Metro Bank £16.7m for AML transaction monitoring failings | Foot Anstey

6. Implications and Conclusions

6.1 Theoretical Implications

Our findings extend consumer vulnerability theory by demonstrating that digital capabilities alone cannot overcome structural economic constraints. The three mechanisms we identify, capability mismatch, economic constraints override, and satisfaction illusion, provide a framework for understanding digital-age vulnerability that moves beyond traditional demographic categorisations. This framework challenges Sen's (1999) capability approach by showing that even when consumers possess digital resources, the conversion factors required for improved welfare remain absent due to structural barriers technology cannot address.

6.2 Implications for Consumer Protection Policy

The complete absence of direct technology effects ($\beta = 0.0022$, $p = 0.969$) in Europe's most digitalised economy fundamentally challenges the European Commission's €150 billion digital infrastructure investment. Policymakers must recognise that technology access without capability development and structural

affecting households between the 20th and 70th percentiles—demands targeted

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rather than universal interventions. Regulatory frameworks must evolve from disclosure-based approaches to outcome-based requirements, with firms required to demonstrate actual welfare improvements rather than engagement metrics.

6.3 Implications for Producer Conduct

Financial service providers face both risks and opportunities from our findings. The satisfaction illusion mechanism reveals that current engagement-focused strategies may create short-term gains but long-term customer dissatisfaction and regulatory scrutiny. Table 10 demonstrates how market leaders already recognise this, with innovations like Monzo Plus charging fees only when savings increase, and ING's behavioural coaching achieving 31 per cent better savings outcomes. Providers who continue exploiting the satisfaction illusion through gamification and frictionless spending face reputational damage and potential regulatory sanctions as enforcement intensifies.

6.4 Implications for Consumer Organisations

Consumer advocacy groups must adapt their approaches to address the hidden vulnerability of the squeezed middle who neither identify as vulnerable nor qualify for traditional support programmes. The gender paradox, where women demonstrate superior financial behaviours yet experience worse outcomes, requires advocacy strategies that address structural discrimination rather than assuming capability deficits. Digital advocacy channels risk excluding those most needing support, necessitating maintained non-digital communication and support mechanisms.

6.5 Conclusions

This study of 11,128 Irish households provides evidence that digital technology shows no direct association with consumer financial welfare, operating exclusively through intermediate mechanisms that frequently fail for vulnerable populations. As Europe's

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as a critical test case revealing what awaits other EU member states as digitalisation progresses.

The "squeezed middle" phenomenon we identify reveals a previously hidden form of digital vulnerability affecting 3.9 million people in Ireland alone. If replicated across Europe's 450 million population, this represents over 200 million consumers experiencing no benefit from digital finance despite access. The success of non-digital strategies for rural residents, who achieve 4.6 per cent better well-being without technology, challenges the assumption that digital transformation inherently represents progress.

Ireland's experience provides not universal answers but essential questions each European country must investigate. The path forward requires acknowledging that technology represents a tool rather than a solution. Its value depends entirely on the capabilities consumers possess, the structural conditions within which they operate, and the design choices producers make in developing digital services. Without addressing capability mismatches, structural barriers, and the satisfaction illusion, digital transformation will continue creating an illusion of progress while leaving the most vulnerable behind.

The regulatory implications are clear, disclosure-based consumer protection proves inadequate when technology creates satisfaction without improvement. The market implications are equally stark: providers building business models on the satisfaction illusion face unsustainable futures as consumers eventually recognise the gap between perception and reality. Only through coordinated efforts among regulators, financial institutions, and consumer organisations can digital financial services deliver on their promise of improved consumer welfare rather than merely its illusion.

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Author Contribution

MR wrote the main manuscript text HX completed analysisFC and JB edited and contibuted to the manuscriptAll authors reviewed the manuscript

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