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Gender-Based Risk Aversion and Selection Effects in the Iranian Life Insurance Market: Evidence of Advantageous Selection

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Advantageous selection in the insurance industry refers to a situation in which low-risk individuals, who are typically more risk-averse, demand more insurance coverage. This behavior contradicts the conventional adverse selection theory, which predicts that high-risk individuals demand more insurance. This paper employs a theoretical framework based on constant absolute risk aversion (CARA) utility and bequest functions, combined with an empirical investigation, to provide evidence of advantageous selection in the Iranian life insurance market. It examines gender-based differences in risk aversion and selection effects, with a particular focus on the coexistence of adverse and advantageous selection. The study derives equilibrium demand levels for life insurance among high- and low-risk groups, as well as the pooling equilibrium premium rate, under varying levels of processing costs and risk aversion.

Survey data from 400 policyholders provide empirical support and reflect actual market behavior. The evidence indicates that male policyholders are more risk-averse than their female counterparts, leading to advantageous selection, as more risk-averse individuals are more likely to purchase life insurance. The results also show that higher processing costs accelerate the shift from an adverse to an advantageous selection regime. This occurs because more risk-averse, low-risk individuals value insurance highly enough to tolerate higher premiums and remain in the market, whereas their less risk-averse, high-risk counterparts exit more easily, thereby reinforcing advantageous selection. Similarly, greater risk aversion among low-risk individuals speeds up this transition. The difference in risk aversion between low- and high-risk groups also determines how quickly the shift occurs. Overall, the findings provide evidence of advantageous

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selection in an emerging market and offer practical insights for insurers regarding gender-responsive pricing and risk management.

Keywords: Life Insurance; CARA Utility; Gender Differences; Risk Aversion; Advantageous Selection; Adverse Selection
JEL Classification: G22, D82, D81, C63, J16

1 Introduction

The life insurance market plays a key role in household financial security and long-term capital formation. However, its efficiency is frequently constrained by informational asymmetries between insurers and policyholders. Classical insurance theory suggests that higher-risk individuals are more likely to buy insurance, leading to adverse selection and potential market instability (Akerlof, 1970; Rothschild & Stiglitz, 1976). Some studies, however, show that advantageous selection can also occur, particularly when risk preferences and behavioral characteristics influence insurance demand. This finding challenges the traditional predictions of adverse selection theory (De Meza & Webb, 2001; Finkelstein & McGarry, 2006).

Gender is an important but underexplored factor influencing selection in life insurance markets. Men and women often differ in their attitudes toward risk, financial decision-making, and long-term planning, leading to divergent insurance purchase behaviors. Behavioral evidence generally indicates that men exhibit greater risk-taking tendencies, whereas women display higher risk aversion (Croson & Gneezy, 2009; Eckel & Grossman, 2008). These insights are seldom included in formal life insurance selection models. Understanding whether gender-based selection patterns exist is crucial for refining pricing, underwriting, and policy design. This study also examines gender-specific differences in risk aversion and how they contribute to advantageous selection in the Iranian life insurance market.

The primary objective of this paper is to provide evidence of advantageous selection in the life insurance market, with a specific focus on gender differences between males and females in Iran. To test for the existence of advantageous selection, we first maximize the expected utility of a family, assuming that both utility and bequest functions follow the constant absolute risk aversion (CARA) class. This allows us to derive parametric life insurance demand functions for both high- and low-risk groups. By inserting the derived demand functions into the profit maximization problem under perfect competition, the pooling equilibrium premium rate is obtained. In the second step, to empirically test for advantageous selection among male and female life insurance purchasers, we analyze survey data collected from 400 policyholders. This analysis assesses gender-based differences in risk aversion and their associated selection effects. In the third step, we conduct sensitivity

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analyses on processing costs and risk aversion heterogeneity by assigning different parameter values to the demand functions of both groups, allowing us to examine how the nature of selection evolves as these parameters vary. All graphs and numerical simulations were generated using Python (V. 3.10.12) and R (V. 4.5.2).

The remainder of this paper is structured as follows. Section 2 reviews the theoretical foundations and literature on selection models and gender-based risk behavior. Section 3 presents the empirical analysis and simulation results. Section 4 discusses the key findings from the theoretical model and numerical simulations. Section 5 concludes, addresses policy implications, and suggests avenues for future research.

2 Theoretical Foundation and Literature Review

The theoretical foundation of information asymmetry in insurance markets was established by Rothschild and Stiglitz (1976), who demonstrated that adverse selection arises when high-risk individuals disproportionately purchase insurance, thereby threatening market efficiency. Traditional models based on this premise assumed a positive correlation between perceived and actual risk, predicting that asymmetric information would inherently favor policyholders. However, empirical research began to challenge these classical expectations. Hemenway (1990) proposed the concept of "propitious selection," arguing that highly risk-averse individuals are more likely to both reduce hazards and purchase insurance, leading to a healthier risk pool. Jianakoplos and Bernasek (1998) provided early evidence on demographic variations in risk preferences, noting significant gender differences in financial risk-taking. Building on these behavioral insights, Cawley and Philipson (1999) and Jullien et al. (1999) demonstrated that insured individuals often exhibit greater risk aversion and precautionary behavior. Similarly, De Meza and Webb (2001) extended the literature by illustrating how optimism bias might cause high-risk individuals to underestimate hazards, thereby reducing their insurance uptake. Dachraoui et al. (2004) further confirmed that self-protection and preventive efforts increase alongside risk aversion.

By the mid-2000s, the focus expanded toward the formalization of advantageous selection and the role of regulation. McGarry and Schoeni (2005) found that risk-averse households consistently adopt protective financial behaviors. Theoretical advancements by De Donder and Hindriks (1998) clarified that the "propitious selection" argument requires specific conditions—such as a decreasing marginal willingness to pay among less risk-

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averse individuals—to truly generate a negative correlation between risk levels and insurance purchases. Concurrently, Mahdavi and Rinaz (2006) provided empirical evidence that highly risk-averse, low-risk individuals willingly accept higher premiums, thus improving insurers' portfolios. From a regulatory perspective, Polborn et al. (2006) modeled "regulatory adverse selection," demonstrating that government prohibitions on using specific information (such as genetic testing) for risk-rating life insurance premiums could, counterintuitively, enhance overall social welfare.

As the literature progressed, researchers sought to isolate the specific sources of selection biases. Fang et al. (2008) identified that advantageous selection in the Medigap insurance market is driven not merely by risk preferences, but predominantly by cognitive ability, income, education, and financial planning horizons. Croson and Gneezy (2009) reinforced the understanding of demographic influences, confirming that women generally exhibit greater risk aversion and prefer comprehensive coverage. To synthesize the growing empirical literature, Cohen and Siegelman (2010) evaluated the coverage-risk correlation across various markets, noting that the presence of adverse selection varies significantly depending on the specific insurance pool and that distinguishing it from moral hazard remains a critical methodological challenge. Empirical momentum continued as Einav et al. (2010) documented a stronger propensity among the risk-averse to hold stable annuities. Einav and Finkelstein (2011) subsequently provided a comprehensive graphical framework to analyze both adverse and advantageous selection, illustrating how the latter fundamentally alters equilibrium allocations and optimal public policy. Around this time, Zhou-Richter and Gründl (2011) and Brown and Finkelstein (2008) highlighted the dynamic coexistence of different selection types based on age, gender, and long-term care needs. Colquitt et al. (2012) added empirical weight to the adverse selection theory by documenting its presence in the highly regulated U.S. credit life insurance market, where underwriting is limited.

In subsequent years, the dynamic nature of policyholder behavior gained further attention. Mahdavi and Abed (2015) found that high-risk individuals are more prone to lapsing policies, whereas low-risk, risk-averse individuals maintain coverage over time. Hedengren and Stratmann (2016) tested life insurance markets and found evidence contrary to standard adverse selection; instead, they demonstrated that price discrimination and advantageous selection dominate individual life insurance markets. Complementing this, Luciano et al. (2016) analyzed Italian households and confirmed that gender, alongside financial market proximity, significantly dictates life insurance

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demand, with women generally exhibiting a lower likelihood of being insured despite their risk aversion. Regulatory interventions, such as prohibitions on gender-based pricing, have been shown to unintentionally intensify advantageous selection by altering market composition (Huang & Salm, 2020).

Recent studies have increasingly relied on sophisticated data to untangle complex market dynamics. Harris et al. (2023) utilized payroll and healthcare claims to show that while adverse selection exists in employer-sponsored life insurance, employees are remarkably price-insensitive, meaning the resulting premium increases cause negligible welfare loss. Several significant contributions to the literature appeared in 2024. Dionne et al. (2025) provided an extensive survey on multi-period contracting, renegotiation, and the simultaneous modeling of moral hazard and adverse selection. Similarly, Marvasti and Dakhlia (2024) isolated self-selection from moral hazard in commercial fisheries, finding that while advantageous selection initially appears present, it dissipates when controlling for insurer information, leaving moral hazard as the dominant force. Most recently, Rahadian et al. (2025) synthesized findings from developing countries, specifically in Indonesian healthcare, highlighting that adverse selection remains prevalent in voluntary schemes with low insurance literacy. They concluded that mitigating these risks requires a multi-dimensional approach combining mandatory enrollment, targeted subsidies, and advanced technologies like machine learning for risk adjustment.

As the literature demonstrates, a consistent narrative has emerged. On the one hand, modern insurance theory acknowledges the prevalence of advantageous selection, a phenomenon critically driven by policyholders' risk aversion. On the other hand, a robust body of behavioral research confirms that gender is a significant predictor of risk attitudes, with women consistently exhibiting higher levels of risk aversion. Despite these well-established parallel findings, a notable gap remains in the literature regarding the empirical integration of these concepts. Few studies have systematically investigated how gender-based differences in risk aversion translate into selection patterns, particularly within the specific context of the life insurance market in an emerging economy like Iran. Moreover, much of the existing empirical work relies on correlational analysis, while a formal test of the advantageous selection hypothesis grounded in a theoretical behavioral model like the CARA utility framework remains scarce, especially using primary survey data.

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This study is designed to directly address this multifaceted gap. By developing and calibrating a CARA utility-based model of insurance demand using unique survey data from Iranian market, this paper contributes by explicitly connecting gender, risk aversion, and insurance choice within a unified theoretical and empirical framework. It therefore provides novel evidence on the mechanisms of selection in the under-researched context of an emerging life insurance market, moving beyond simple correlation to model the underlying behavioral drivers of advantageous selection.

This study integrates a formal theoretical model with empirical calibration to examine gender-based adverse and advantageous selection in the Iranian life insurance market. The methodology proceeds through three main phases: developing a formal analytical framework based on utility maximization under asymmetric information; structuring the market equilibrium under conditions of perfect competition among insurers; and empirically calibrating the model parameters using survey data focusing on Iranian policyholders.

We model a perfectly competitive life insurance market in which individuals differ in both risk exposure and risk aversion. Preferences are represented by utility and bequest functions exhibiting constant absolute risk aversion (CARA). This dual structure reflects utility realized during an insured's lifetime (utility function) and the welfare conveyed to beneficiaries upon death (bequest function). The mathematical specification ensures tractability while capturing essential economic behavior:

$$U(W) = B(W) = 1 - e^{-\alpha W} \qquad 0 < \alpha < 1 \tag{1}$$

where W represents wealth and the parameter α denotes the degree of risk aversion.

The first-order and second-order derivatives of this utility function are crucial for deriving optimal behavior:

$$B'(W) = U'(W) = \alpha e^{-\alpha W} > 0$$
$$B^{"}(W) = U^{"}(W) = -\alpha^2 e^{-\alpha W} < 0$$

The positivity of the first derivative confirms monotonicity (more wealth is preferred), while the negativity of the second derivative confirms risk aversion. The Absolute Risk Aversion Index (ARAI) is obtained as:

$$ARAI = -\frac{U^{"}(w)}{U'(w)} = \alpha \tag{2}$$

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Thus, the constant parameter α directly quantifies each individual's degree of risk aversion.

The following model incorporates endogenous precautionary effort (e_i), linking risk aversion (α_i) to the probability of death ($p_i(e_i)$). Specifically, the probability of death is modeled to decrease as risk aversion increases, reflecting the intuition that more risk-averse individuals undertake greater precautionary measures. We assume effort is costly to the individual but reduces their probability of death. To proceed, two discrete risk groups are considered:

1) Low-Risk Group (L): Characterized by parameters (α_L, p_L, e_L).
2) High-Risk Group (H): Characterized by parameters (α_H, p_H, e_H).

The relationship between these parameters is typically structured such that: $\alpha_L > \alpha_H \quad and \quad p_L < p_H$.

The equilibrium analysis involves the simultaneous determination of optimal individual demand under asymmetric information and optimal pricing strategies by competitive insurers. Individuals choose the life insurance benefit (x_i) to maximize their expected utility (EU_i), given the premium (qx_i) charged by the insurer, where q is the net premium rate and x_i represents the benefit paid upon death and is taken as the index measuring demand for insurance (Mahdavi & Rinaz, 2006). Let W_i denote wealth, Y_i represent the income, p_i be the probability of death. The expected utility maximization problem for an individual in group i ($i = L \; or \; i = H$) is:

$$\max_{x_i} EU_i(x_i) = (1 - p_i)U_i(W_i + Y_i - qx_i - e_i) + p_i B_i(W_i + x_i) \tag{3}$$

The first-order condition (FOC) for optimal benefit choice (x_i^*) is derived by setting the marginal expected utility with respect to x_i to zero:

$$\frac{\partial EU_i}{\partial x_i} = -q(1 - p_i)U_i'(W_i + Y_i - qx_i - e_i) + p_i B_i'(W_i + x_i) = 0 \tag{4}$$

This yields an implicit equation for the optimal benefit choice. Under the specific CARA structure equation (1) and assuming full information about p_i (but asymmetric information regarding α_i which influences p_i through e_i), the optimal demand x_i^* is derived.

$$x_i{}^*(q) = \frac{L_i(q) - (e_i - Y_i)}{(1+q)} \tag{5}$$

where,

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$$L_i(q) = \left(-\frac{1}{\alpha_i}\right) ln\left\{\frac{q(1-p(e_i))}{p(e_i)}\right\},\ i \in \{L, H\}$$

We assume that insurers operate in a perfectly competitive market; therefore, expected profits are zero. The insurance companies cannot observe the true risk type, leading to a single pooling premium. The expected profit for an insurer offering coverage x_i at a premium rate q to a population of type i is:

$$\pi(q) = \sum_{i=H,L}[(1 - p(e_i))q - p(e_i)(c + 1)]x_i^*(q) = 0 \quad (6)$$

where c represents the processing cost. The insurer wants to maximize the profit, so:

$$\max_q \pi(q) = \max_q \sum_{i=H,L}[(1 - p(e_i))q - p(e_i)(c + 1)]x_i^*(q) = 0 \quad (7)$$

Substituting the equilibrium level of insurance demand $x_i^*(q)$ from equation (5) into equation (7) and solving for the pooling-equilibrium premium rate q^*, the zero-expected-profit condition implies that $q^*$is

$$q^* = \frac{\sum_{i=H,L} p_i(1+c)x_i{}^*(q)}{\sum_{i=H,L}(1-p_i)x_i{}^*(q)} \quad (8)$$

The selection is determined by the way the demand $x_i{}^*(q)$ changes across groups according to the risk inherent in those groups, driven primarily by the processing cost c.

Given that the derivative $\frac{dL_i(q)}{dq} = -\frac{1}{q\alpha_i}$ is negative for all $\alpha_i > 0$ and $q > 0$, each function $L_i(q)$ is strictly decreasing. Under the condition that $\alpha_H < \alpha_L$, the inequality $| L_L'(q) | < | L_H'(q) |$ holds. This implies that $L_H(q)$ exhibits a steeper rate of descent than $L_L(q)$ across all points. Crucially, this differential in the rate of decrease extends to the optimal demands, causing $x_H^*(q)$ to decline more rapidly than $x_L^*(q)$. As a direct consequence of their monotonicity and different slopes, the two functions can intersect only once.

3 Empirical Evidence

Based on the equilibrium demand functions derived for both groups of high- and low-risk individuals, the market selection regime is classified into two categories. An Adverse Selection regime is identified when the equilibrium demand of the high-risk group exceeds that of the low-risk group ($x_H^* > x_L^*$). Conversely, an Advantageous Selection regime occurs when the low-risk

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individuals demand more coverage ($x_L^* > x_H^*$). The point at which $x_H^* = x_L^*$ marks the boundary or the transition threshold between the two regimes.

To ensure a strong linkage between theoretical foundations and empirical analysis, this study adopts an empirically calibrated simulation approach, organized into three sequential steps:

First, the optimal insurance demand functions (x_L^* and x_H^*) are derived theoretically, demonstrating that equilibrium demand is sensitive to the risk aversion parameter (α). Second, rather than relying on arbitrary simulation values, we empirically measure the degrees of risk aversion using a sample of 400 life insurance policyholders. The empirical findings yield a mean risk aversion of $\alpha_{L_{\text{Male}}} = 0.81$ for males and $\alpha_{L_{\text{Female}}} = 0.58$ for females. The results of the present study also indicate that, in the examined sample, men purchase life insurance more frequently than women. Given that both groups exhibit risk aversion coefficients above 0.5, we reasonably assume that the life insurance market primarily attracts highly risk-averse individuals, with men demonstrating higher risk aversion levels than women. Finally, the linkage between theory and practice is established by inserting the risk aversion levels of males and females into the theoretical model to test for the existence of advantageous selection. To evaluate how these empirical gender differences alter market dynamics, we utilize the male risk aversion coefficient (0.81) and the female coefficient (0.58) in the baseline simulation, where the processing cost (c) increases incrementally. The simulation results reveal a critical dynamic: when α_L is parameterized with the male coefficient, the equilibrium demand of the low-risk group exceeds that of the high-risk group ($x_L^* > x_H^*$) at a notably lower processing cost threshold (c_{crit}) of 0.693 for males, compared to 0.947 for females.

The empirical results for both male and female life insurance policyholders are reported in Tables 1 and 2 below.

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Table 1
The Impact of Increasing Processing Cost on the Selection Regime Transition for Males

Processing Cost (c)	q^*(Equilibrium Premium Rate)	$x^*_{L_{Male}}$(Low-Risk Demand)	$x^*_{H_{Male}}$ (High-Risk Demand)	Selection Regime
0.0	0.01528447	88.1119	90.04914	Adverse
0.1	0.01680191	87.86547	89.44929	Adverse
0.2	0.01831832	87.62987	88.89182	Adverse
0.3	0.0198338	87.40343	88.37002	Adverse
0.4	0.02134839	87.18487	87.87872	Adverse
0.5	0.02286217	86.97315	87.41379	Adverse
0.6	0.02437518	86.76746	86.97189	Adverse
0.693	0.02578164	86.58098	86.57921	Advantageous
0.7	0.02588747	86.56711	86.55031	Advantageous

Parameters: income $(Y_{L_{Male}}, Y_{H_{Male}}) = (90,90)$; risk aversion $(\alpha_{L_{Male}}, \alpha_{H_{Male}}) = (0.81,0.2)$; death probability $(p_{L_{Male}}, p_{H_{Male}}) = (0.01,0.02)$; and precautionary effort $(e_{L_{Male}}, e_{H_{Male}}) = (0.03,0.02)$. The transition from adverse to advantageous selection occurs at the critical processing cost $c_{\text{crit}} = 0.693$ Source: Research findings

Table 1 shows that Iranian male policyholders exhibit advantageous selection behavior, with a critical processing cost of 0.693. Table 2 examines the same behavior for female policyholders of life insurance. As the table indicates, female policyholders switch to advantageous selection at a higher critical processing cost of 0.947.

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Table 2
The Impact of Increasing Processing Cost on the Selection Regime Transition for Females

Processing Cost (c)	q^*(Equilibrium Premium Rate)	$x^*_{L_{Female}}$(Low-Risk Demand)	$x^*_{H_{Female}}$ (High-Risk Demand)	Selection Regime
0.0	0.01529028	87.91102	90.04675	Adverse
0.1	0.01680977	87.619	89.4463	Adverse
0.2	0.01832838	87.3419	88.88824	Adverse
0.3	0.01984616	87.07741	88.3659	Adverse
0.4	0.02136318	86.82373	87.87406	Adverse
0.5	0.02287948	86.57944	87.40861	Adverse
0.6	0.02439511	86.34339	86.96621	Adverse
0.7	0.02591012	86.11463	86.54414	Adverse
0.8	0.02742453	85.89237	86.14013	Adverse
0.9	0.02893837	85.67597	85.7523	Adverse
0.947	0.02964969	85.57612	85.57514	Advantageous
0.99	0.03030037	85.48574	85.41575	Advantageous

Parameters: income $(Y_{L_{Female}}, Y_{H_{Female}}) = (90,90)$; risk aversion $(\alpha_{L_{Female}}, \alpha_{H_{Female}}) = (0.58,0.2)$; death probability $(p_{L_{Female}}, p_{H_{Female}}) = (0.01,0.02)$; and precautionary effort $(e_{L_{Female}}, e_{H_{Female}}) = (0.03,0.02)$. The transition from adverse to advantageous selection occurs at the critical processing cost $c_{\text{crit}} = 0.947$. Source: Research findings

As Tables 1 and 2 demonstrate, an increase in the processing cost (c) induces a regime shift from adverse to advantageous selection. As c increases, the equilibrium premium rate (q^*) rises. In this case, the demand of the high-risk group (x^*_H) decreases more sharply than that of the low-risk group (x^*_L). This reflects the fact that low-risk individuals place a high value on insurance and therefore continue to purchase coverage even when premium rates are higher. For costs below the critical threshold ($c < c_{crit}$), we observe $x^*_H > x^*_L$, indicating adverse selection. At $c \geq c_{crit}$, the relationship reverses, signaling a shift to advantageous selection.

To illustrate how heterogeneity in risk aversion ($\Delta\alpha = \alpha_L - \alpha_H$) interacts with processing costs (c) to determine the selection regime, we plot the demand functions of both groups (x^*_H *and* x^*_L) and the pooling equilibrium premium rate q^* against the processing cost c. For graphical compatibility, the pooling equilibrium premium rate q^* is multiplied by 1000 to allow plotting on the same scale as the demand values. Figure 1 presents scenarios in which

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baseline probabilities and precautionary efforts are held fixed, while the risk-aversion parameters α vary across scenarios.

This figure plots the equilibrium demand of the low-risk and high-risk groups, along with the equilibrium premium rate, against the processing cost under different risk-aversion parameterizations. The results illustrate that widening heterogeneity in risk aversion ($\Delta\alpha$)—from Scenario 1 to Scenario 4—amplifies demand divergence across groups and induces a regime shift at lower processing costs. Consequently, the critical cost threshold for the regime shift (c_{crit}) becomes smaller. Markets with greater heterogeneity in risk aversion transit to advantageous selection at lower levels of processing cost. This occurs because, as heterogeneity in risk aversion increases, the marginal increase in low-risk individuals' equilibrium demand (x_L^*) exceeds the marginal reduction in high-risk individuals' equilibrium demand (x_H^*), reflecting the lower sensitivity of the latter group to changes in risk aversion. Across all scenarios, the equilibrium premium rate q is positively related to processing cost (c).

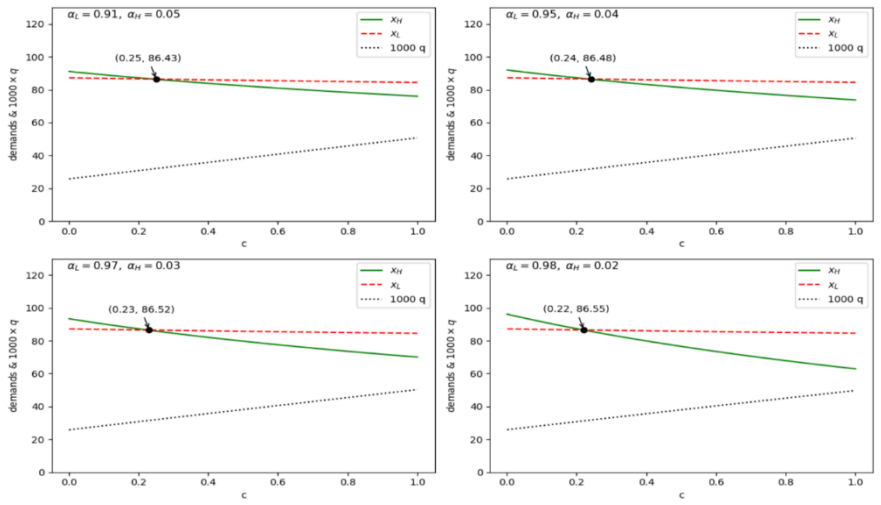

Figure 1. The Impact of Processing Costs on the Selection Regime under Different Degrees of Risk Aversion Heterogeneity

a)Y_L =90, Y_H = 90, p_L = 0.02, p_H = 0.03, e_L = 0.3, e_H = 0.2, α_L = 0.91, α_H =0.05
b)Y_L =90, Y_H = 90, p_L = 0.02, p_H = 0.03, e_L = 0.3, e_H = 0.2, α_L = 0.95, α_H =0.04
c)Y_L =90, Y_H = 90, p_L = 0.02, p_H = 0.03, e_L = 0.3, e_H = 0.2, α_L = 0.97, α_H =0.03
d)Y_L =90, Y_H = 90, p_L = 0.02, p_H = 0.03, e_L = 0.3, e_H = 0.2, α_L = 0.98, α_H =0.02

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As illustrated in the figure, both the endogenous rise in processing cost (moving from left to right) and the exogenous increase in risk aversion differentials across the four simulation scenarios drive the regime from adverse selection toward advantageous selection. Here the expression "endogenous" is used to simply mean that we will draw the evolution of price and demands as functions of the processing cost. It does not imply any change in the underlying modeling assumptions; the processing cost remains a fixed parameter that cannot be freely altered by insurers or insureds. Each point on the resulting curves represents a different parameter configuration. We examine whether advantageous selection can arise naturally under this framework for some parameter values.
Source: Research findings

Next, we assess the impact of the low-risk group's risk aversion (α_L) by fixing the high-risk group's risk aversion parameter (α_H) at a low constant value ($\alpha_H = 0.01$). For a given processing cost, if there exists a threshold value of α_Lat which the demands of the low- and high-risk groups coincide ($x_L^* = x_H^*$), then, beyond this threshold, the market regime shifts to advantageous selection. However, such a threshold may not exist within the range of α_L considered for all processing-cost levels.

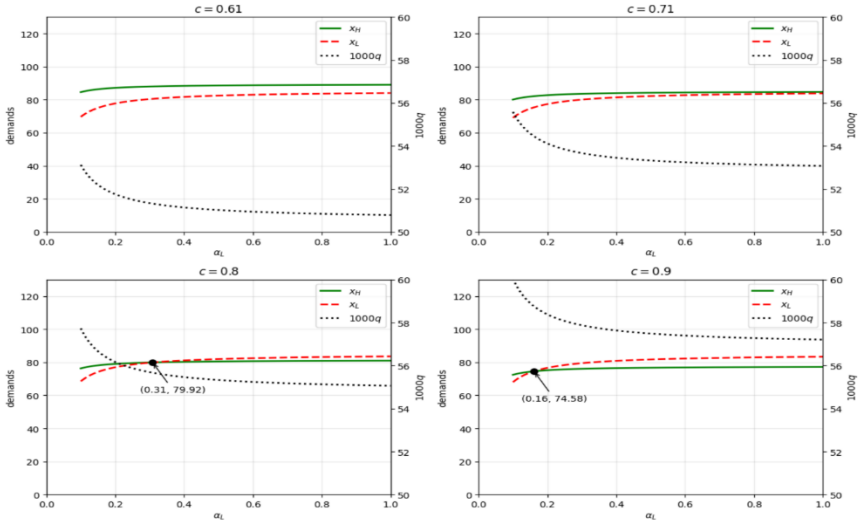

Figure 2. The Impact of Low-Risk Individuals' Risk Aversion on the Selection Regime Across Processing Cost Levels:
e)Y_L =90, $Y_H = 90, p_L = 0.01, p_H = 0.05, e_L = 0.091, e_H = 0.015, c = 0.61, \alpha_H$ =0.01
f)Y_L =90, $Y_H = 90, p_L = 0.01, p_H = 0.05, e_L = 0.091, e_H = 0.015, c = 0.71, \alpha_H$ =0.01
g)Y_L =90, $Y_H = 90, p_L = 0.01, p_H = 0.05, e_L = 0.091, e_H = 0.015, c = 0.8, \alpha_H$ =0.01
h)Y_L =90, $Y_H = 90, p_L = 0.01, p_H = 0.05, e_L = 0.091, e_H = 0.015, c = 0.9, \alpha_H$ =0.01

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The figure depicts four simulation scenarios of equilibrium demands and pooling equilibrium price as a function of the low-risk group's risk aversion parameter α_L for different levels of processing costs. As processing costs increase in scenario 1 to 4, equilibrium demand declines for both groups; however, the reduction in demand is smaller for low-risk individuals, who value insurance more highly and therefore remain in the market longer than high-risk individuals. As a result, the transition to advantageous selection occurs at lower values of α_L. Source: Research findings

This figure plots the equilibrium demands and pooling equilibrium premium rates against the low-risk group's risk aversion (α_L) across four distinct processing cost levels. The results indicate that as α_L increases, the demand curve for the low-risk group (x_L) rises and gradually flattens, reflecting the sensitivity of insurance demand to risk aversion. Conversely, the high-risk demand (x_H) remains relatively stable due to their fixed, low risk aversion level (α_H). Consequently, a sufficiently high $\alpha_L$leads to $x_L^* > x_H^*$, triggering a transition to advantageous selection. As illustrated, at higher processing costs (e.g., $c = 0.9$) in scenario 4, this transition occurs at lower levels of risk aversion compared to lower costs in other scenarios. Furthermore, the equilibrium premium q^*exhibits an inverse relationship with α_L ($\frac{dq}{d\alpha_L} < 0$), as greater participation of low-risk individuals improves the pool's quality and reduces the equilibrium premium.

4 Discussion: Findings from Theoretical Modeling and Numerical Simulation

The numerical analysis of the theoretical model reveals how market structure influences the demand for insurance for both groups and the pooling equilibrium price. The findings focus on the impact of two pivotal parameters: the policy processing cost (c) and the heterogeneity in risk aversion.

We first analyze the sensitivity of insurance demand and the market equilibrium price to changes in the processing cost. As reported in Tables 1 and 2, an increase in the processing cost (c) systematically alters the selection regime. For costs below a critical threshold, the market operates under adverse selection, characterized by $x_L^* < x_H^*$. The numerical analysis identifies a critical processing cost of approximately $c_{\text{crit}} \approx 0.693$ for males, at which the regime shifts to advantageous selection. For females, the critical value is higher, at $c_{\text{crit}} \approx 0.947$. For any processing cost satisfying $c > c_{\text{crit}}$, the equilibrium transitions to an advantageous selection regime, where demand from low-risk individuals exceeds that of high-risk individuals ($x_L^* > x_H^*$).

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According to the conventional theory of insurance demand, less risk-averse individuals (high-risk individuals) initially demand more insurance than more risk-averse individuals (low-risk individuals). An increase in the processing cost raises the pooling equilibrium price, which in turn reduces demand for both groups in accordance with the law of demand. Because the price elasticity of demand is lower for more risk-averse individuals (low-risk types)—as they can better tolerate higher premium rates than less risk-averse individuals (high-risk types)—the demand levels converge as costs rise, ultimately leading to a shift from adverse to advantageous selection. Figure 1 provides a graphical representation of this regime shift, plotting the demand functions for both groups across the range of processing costs.

We next examine the role of heterogeneity in risk aversion (Δα). As shown in Figure 1, moving from Scenario 1 to Scenario 4 corresponds to an increase in the gap between risk-aversion levels. As this gap widens, the regime shifts toward advantageous selection at lower threshold levels of processing cost (c_{crit}). The underlying intuition is that when more risk-averse individuals (low-risk types) become even more risk averse, the marginal increase in their insurance demand exceeds the marginal decrease in demand by less risk-averse individuals (high-risk types) as their risk aversion declines. Consequently, greater heterogeneity in risk aversion causes the regime change to occur at lower processing-cost thresholds. This mechanism explains why the critical processing cost at which the regime switches to advantageous selection declines in Figure 1—from 0.25 in Scenario 1, to 0.24 in Scenario 2, and finally to 0.22 in Scenario 4.

Figure 2 shows that as the risk aversion of the low-risk group (α_L) increases, the gap between the equilibrium demand levels ($x_L^* \; and \; x_H^*$) narrows, and the regime shifts toward advantageous selection. As processing costs rise from Scenario 1 to Scenario 4, this regime change occurs at lower values of α_L. In all scenarios, increases in α_L from left to right raise x_L^* and further reduce its gap with x_H^*. In other words, a higher degree of risk aversion among low-risk individuals accelerates the transition to an advantageous selection equilibrium, making the market more resilient to adverse selection.

This study contributes a renewed perspective to the debate on selection dynamics by demonstrating how institutional costs and consumer psychology jointly determine equilibrium outcomes. The central insight is the dual role of processing costs, which, rather than merely impeding efficiency, act as a self-selection mechanism. When costs exceed a critical threshold, they disproportionately deter price-sensitive, high-risk individuals, pushing the market toward an advantageous selection equilibrium. However, the

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effectiveness of this mechanism depends critically on the behavioral characteristics of the low-risk population.

Our numerical illustrations show that increased risk aversion among low-risk consumers helps sustain their demand as costs increase. The empirical evidence lends concrete support to this theoretical effect: survey data from 400 Iranian life insurance policyholders reveal a pronounced gender asymmetry, with male respondents ($\alpha_{L_{Male}} \approx 0.81$) exhibiting significantly higher risk aversion than females ($\alpha_{L_{Female}} \approx 0.58$). The resulting demographic differences mirror the type heterogeneity in our model, indicating that markets dominated by highly risk-averse consumers—analogous to the male cohort in this study—are more prone to advantageous selection. The main consequence of gender-based differences in risk aversion is reflected in the critical value of the processing cost. The numerical illustration shows that the critical cost threshold (c_{crit}) for males is 0.693, compared to 0.947 for females, indicating a wider range of advantageous selection for males.

These findings provide a structural and behavioral explanation that enriches the existing literature on advantageous selection. While previous research has established the empirical prevalence of advantageous selection (e.g., Hemenway, 1990; Cawley & Philipson, 1999) and the role of risk aversion (De Meza & Webb, 2001), this study moves beyond static associations to uncover a dynamic process. Our contribution lies in formally modeling the interaction between an institutional factor (processing costs) and a psychological trait (risk aversion). We demonstrate that advantageous selection is not simply a product of high costs or high-risk aversion alone, but emerges where economic pressure and behavioral caution reinforce each other. By grounding this interaction in a CARA-utility framework and substantiating it with primary data on gender differences from an emerging market, this paper bridges a critical gap and provides a replicable framework for understanding the transformation between selection regimes.

The implications of these findings are substantial for both industry practice and public policy. For insurers, our results suggest that cost and fee structures can be used not merely as revenue channels but as strategic levers to influence the risk composition of their portfolios. By carefully designing non-premium costs, firms could potentially create an environment that is more attractive to the stable, low-risk segment of the market, thereby enhancing portfolio health and long-term profitability. However, policymakers should approach these effects with caution. Systems that attract low-risk individuals may also exclude higher-risk, more vulnerable groups who cannot afford coverage. This

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underscores a core tension between market efficiency and social equity. Balancing financial stability in the insurance sector with broad access to coverage is therefore a key policy challenge.

Despite its strong analytical approach, this study has some limitations that point to directions for future research. The model simplifies reality by focusing on two representative agent types, rather than a continuous range of risks and preferences. In addition, the empirical analysis is limited to the life insurance market in Iran. Future studies should examine these mechanisms in other settings, such as health or annuity markets, and in different countries to test how general the results are. Finally, the model could be enriched by incorporating other behavioral dimensions, such as financial literacy, optimism bias, or varying time preferences, to develop a more comprehensive understanding of the drivers behind advantageous selection. Even so, this study provides a clear, evidence-based framework for addressing a central question in insurance economics.

5 Conclusion

This paper aims to provide evidence of advantageous selection in Iran's life insurance market, focusing on gender differences. We first derived parametric demand functions for high- and low-risk groups using a CARA utility framework and obtained the pooling equilibrium premium under perfect competition. We also analyzed survey data from policyholders to assess gender-based differences in risk aversion. Sensitivity analyses on processing costs and risk aversion heterogeneity were conducted to examine how the selection regime evolves as these parameters vary. Together, these steps reveal how gender influences the transition from adverse to advantageous selection in an emerging market.

This study investigates the nature of gender-based selection dynamics in the Iranian life insurance market by integrating individual behavioral characteristics—specifically risk aversion—with market structure. By developing a theoretical framework grounded in Constant Absolute Risk Aversion (CARA) utility and bequest functions, we modeled how heterogeneous risk preferences interact with institutional factors, such as processing costs, to shape market equilibrium. The model was then calibrated using unique survey data from 400 Iranian policyholders, providing a distinctive empirical insight into the Iranian life insurance market.

The findings yield several important insights. First, the analysis confirms that the insurance market is not static in its selection regime; rather, the nature of selection—whether adverse or advantageous—is a function of the interplay

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between policyholder psychology and market costs. Our numerical simulations demonstrate that an increase in processing costs acts as an endogenous screening mechanism. When costs exceed a critical threshold, the market predictably transitions from an adverse to an advantageous selection equilibrium, as the demand from price-sensitive, high-risk individuals erodes faster than that from risk-averse, low-risk individuals.

Second, the heterogeneity of risk aversion within the population plays a pivotal role. The model shows that a wider gap in risk aversion between low-risk and high-risk groups lowers the critical processing cost required for the regime shift, thereby accelerating the transition to a more stable, advantageously selected pool. This highlights the importance of measuring and understanding the distribution of risk preferences, not just average levels.

Third, this research provides direct empirical evidence of a significant gender-based asymmetry in risk preferences within the Iranian context. Contrary to findings in many studies, our survey data reveals that male policyholders exhibit a markedly higher degree of risk aversion (0.81) compared to their female counterparts (0.58). This finding not only substantiates supports the model's assumption of heterogeneous types but also identifies a concrete demographic axis—gender—along which advantageous selection operates.

The findings carry significant implications for both insurers and policymakers. For insurers, the results suggest that administrative cost structures can be viewed as strategic tools for portfolio management. By understanding the risk-aversion profile of their target demographics, firms can calibrate non-premium costs to cultivate a healthier risk pool. For regulators, however, this mechanism presents a nuanced challenge.

Our contribution is formally modeling how processing costs and risk aversion interact to produce advantageous selection. We show that advantageous selection arises not from high costs or high-risk aversion alone, but when both economic pressure and behavioral caution reinforce each other. Using a CARA utility framework and primary gender-disaggregated data from an emerging market, we provide a replicable model for understanding regime shifts in insurance selection. While prior research has documented the empirical presence of advantageous selection and the role of risk aversion, our study moves beyond static associations to uncover the underlying dynamic process, offering a structural and behavioral explanation that enriches the existing literature. In sum, this paper contributes to the literature by moving beyond static correlations. It offers a formal, theoretically grounded model that demonstrates how the interaction of institutional frictions (processing

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costs) and behavioral traits (risk aversion) creates a dynamic pathway for the emergence of advantageous selection. By linking this interaction to primary data, we establish a replicable framework for understanding selection dynamics—one that moves beyond what previous studies have offered.

This study has several limitations that suggest directions for future research. The model simplifies reality by using two representative agent types rather than a continuous distribution of risks and preferences. Empirically, the analysis is confined to Iran's life insurance market. To test the generalizability of our findings, future studies should examine other settings, such as health or annuity markets, and other countries. Additionally, incorporating other behavioral dimensions—such as financial literacy, optimism bias, or varying time preferences—could enhance our understanding of advantageous selection. Despite these limitations, this study provides a clear, evidence-based framework for a central question in insurance economics.

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