Memon, Sonan

1. CONTEXT

There is clear evidence that "Islamic" banking is rising in prominence. According to industry and regulatory reports, global Islamic financial assets have grown rapidly in recent years (see Islamic Financial Services Board, 2024 and Standard Chartered, 2023). In dual-banking systems such as those in the Middle East and South Asia, share of Islamic banking in total banking assets has increased steadily in recent years; in some cases exceeding 20-25% of banking assets Standard Chartered, 2023[1]. For a critical discussion on the religious philosophy of Islamic banking and history of financial westernization in the Islamic world, refer to Kuran, 2005 and Kuran, 2018 [2].

One possible interpretation of "Islamic" banking is mere branding and re-packaging of the same underlying financial structure as in conventional banks [3]. Even in this scenario, Islamic banking can reduce overall efficiency of the banking system since operation costs are higher for them, due to Shariah[4] compliance requirements. Moreover, it is certainly possible that systematically different types of households and firms consult Islamic banks for banking services. Apart from this adverse selection, profit and loss sharing arrangements between risk neutral Islamic banks and risk-averse clients can also lead to moral hazard problems which do not exist for conventional banks. Lastly, due to lower degree of internalization, exposure and sensitivity to global financial shocks can be low for Islamic banks relative to conventional banks which reduces their exposure to both positive and negative global, financial shocks.

Increase in Islamic banking is likely to benefit consumers who have strong, innate preferences for such banking due to religious reasons and those who value *perceived* low risk returns on tangible investment projects. Islamic bank entry also increases competition in

[1]For instance, Islamic banking assets in Pakistan have recently been reported at about 25% % of total banking assets and close to 32% in Malaysia.

[2]One key source of institutional inertia is related to the Islamic inheritance system which limits capital accumulation. Another issue lies with corporate legal person-hood: granting an entity independent legal existence, the ability to own property, and limited liability for investors was central to Western commercial expansion in the early modern and industrial periods. Meanwhile, in Islamic jurisprudence, legal personality is more narrowly conceived. Lastly, interest rates or Ribba is forbidden in Islam.

[3]ÇokgezenKuran, 2015 make the case that "Islamic credit cards" in Turkey do not involve any real financial innovation.

[4]These are religious bodies, which determine whether Islamic principles are being followed by the bank.

the banking industry and financial inclusion in a developing economy like Pakistan with high degree of religiosity. Hence, the partial equilibrium effects of Islamic banking are likely to be positive for consumers as a whole. Nevertheless, the general equilibrium effects are not clear since rise in Islamic banking damages innovation in finance such as use of cryptocurrencies and stifles growth by restricting investment to low-risk and low return investments rather than high-risk, high-return investments which are major sources of innovation.

2. Literature Review

The study of competition in banking examines how market structure, regulation, and information asymmetries affect bank behavior, lending practices, and financial stability. A foundational contribution is DiamondDybvig, 1983, which developed a formal model showing that banks are inherently susceptible to runs due to liquidity transformation. Diamond and Dybvig demonstrate that deposit insurance can stabilize banks by preventing self-fulfilling panics, establishing the theoretical link between regulation, liquidity, and financial stability.

Building on the implications of market power and competition, CaminalMatutes, 1997 analyze how market concentration affects the likelihood of banking failures. They show that moderate market power may reduce excessive risk-taking, whereas high concentration can increase systemic vulnerability, highlighting the trade-off between efficiency and stability. AllenGale, 2004 further explore this trade-off, contrasting the roles of bank capital and managerial expertise in competitive banking; their model illustrates that capital requirements alone may not suffice if managerial skill is limited, emphasizing the interaction between regulatory design and internal bank governance. Scott, 1977 complemented this by examining the U.S. dual banking system, demonstrating that regulatory competition between state and federal charters shapes bank's risk profiles, particularly in contexts where public and private banks coexist.

Another strand of research focuses on bank-borrower relationships and monitoring. OngenaSmith, 2001 provide empirical evidence that stronger, longer-term relationships allow banks to monitor borrowers more effectively, which lowers loan rates and credit risk. Similarly, Sharpe, 1990 develop a stylized model showing that implicit contracts between banks and customers can mitigate problems arising from asymmetric information, ensuring more stable lending even under uncertainty. These studies collectively emphasize that competition interacts with relational banking to influence credit allocation.

Extending this to regulatory interactions, Carletti, 2007 model how competitive pressures affect bank risk-taking under varying regulatory frameworks. They demonstrate that in highly competitive markets, banks may increase risk unless prudential regulations such as capital requirements and monitoring incentives are carefully calibrated.

Finally, Kuran, 2005, 2018 examine Islamic banking, highlighting how Sharia-compliant principles shape lending and risk-sharing mechanisms. They argue that profit-and-loss sharing contracts and the prohibition of interest can limit conventional financial inclusion mechanisms, illustrating how institutional and cultural frameworks intersect with market competition to influence access to finance.

My work builds on insights in the literature by explicitly modeling adverse selection, moral hazard and monitoring cost of borrowers. It is related most closely to dual banking system models: Scott, 1977 and work of Kuran, 2018. Apart from being among the first to develop a structural model to quantify the consumer welfare gains of Islamic banking in Pakistan, I provide a generalizable framework in which one can analyze welfare effects in industries where customer preferences are stringent and ideologically motivated. For instance, welfare effects of donations to certain religious institutions such as mosques or churches and war-time aid to victims in Gaza and/or Iran can be analyzed in similar modus operandi.

3. Research Objectives

My research aims to study the evolution of Islamic banking in Pakistan, where the sector has expanded substantially over the past twenty-five years. I focus on the consumer welfare implications of Islamic finance: more specifically for low-income households, small firms, and investment partners of Islamic banks. In particular, I seek to quantify how Islamic financial contracts affects access to credit, pricing, risk allocation, and default outcomes across heterogeneous borrower segments. A central objective is to quantify the degree of improvement in consumer welfare.

Beyond estimation of model parameters, I will use the structural model to conduct policy counter-factuals. The main counter-factual of interest is regulation of Islamic bank advertising: for instance, either via subsidizing such ads or imposing stronger restrictions on ad content though PEMRA[5]. How will government intervention change equilibrium lending rates and crucially consumer welfare?

[5]PEMRA is media regulatory authority in Pakistan.

While general equilibrium effects on consumer welfare are beyond the scope of this project, it is likely that while welfare effects of the rise in Islamic banking on consumers are positive in partial equilibrium sense but are negative when one accounts for deleterious general equilibrium effects of Islamic banking. To this end, a partial equilibrium analysis will assist in quantifying the welfare gains even if the direction is clear.

4. MODEL: BIG PICTURE

In the model, I account for the fact that Islamic banks face *adverse selection* of firms which are less productive and more likely to default. Similarly, household borrowers who self-select into Islamic banking are more likely to default relative to conventional bank borrowers. Lastly, the depositors in Islamic banks are also more likely to withdraw cash relative to Non-Islamic banks[6].

Moreover, Islamic banks engage in "*profit and loss sharing*" in investment projects for which the corresponding asset backed securities are Sukuks, which trade on the stock exchange. While Islamic banks are risk neutral with respect to investment returns in the model, their investment partners are risk-averse which implies that share of investments will be divided across high risk (high return) and low risk (low return) investments; the extent to which investment compositions can respond to information about fundamentals and the portfolio choice depends on degree of asymmetric information. It has also been established that a *moral hazard* exists for CEO's of businesses, increasing share of portfolio in Sukuks when private information indicates higher chance of losses. On the other hand, when expected profits are higher, investment portfolios will be shifted toward traditional bonds and stocks which do not guarantee any fixed, ex-ante profit/losss shares. This implies that demand for Sukuks is counter-cyclical, leading to negative signals about the quality of Sukuks in the market, also shifting the composition of Islamic bank investments toward low risk, low return outcomes.

For consumer segments $s \in \{D^h, D^l, Hh, Hl, Fh, Fl, II, INI\}$, Hh is the high risk household borrower type, Hl is low risk household borrower, Fh is high risk firm borrower, Fl is low risk firm borrower, D^h is depositor with higher probability of withdrawal and D^l is depositor with lower probability of withdrawal. II is investment partner of Islamic bank who is only of one known type: more risk-averse and INI is investment partner of

[6]This is accurate in the Pakistani context of my data since cash continues to be highly used in transactions by the middle and lower economic classes due to challenges with digitization of finance: a third kind of self-selection.

Non-Islamic bank: less risk-averse. Agent $x \in s$ (individual agent in each of the segment) has the following utility specification:[7]

$$u^s_{xbt} = X'_{b,t}\beta^s_{x,b,t} + \delta^s_{x,b} - \alpha^s_{x,b,t} r^s_{bt} - \rho^s_{x,b,t} E_t \sigma^2_{r^s_b} + \varepsilon^s_{xbt} \tag{1}$$

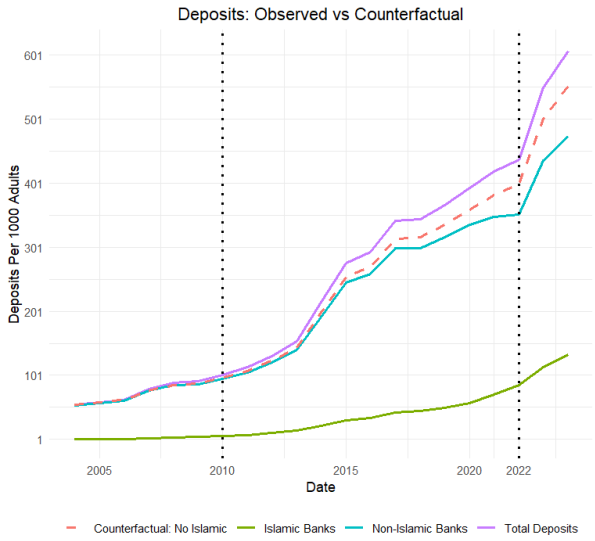
In line of equation 1, the questions that I wish to answer are the following:

- I want to identify un-observable taste parameters for consumers such as time-invariant preference for bank type b for consumer of type s: $\delta^s_{x,b}$.
- In similar spirit, I want to identify the elasticity of consumer utility with respect to interest rates charged by banks in various segments s: $\alpha^s_{x,b,t}$ and degree of risk-aversion across consumer types: $\rho^s_{x,b,t}$.
- What is the effect of Islamic banking's endogenous growth in market share on consumer welfare? While this is likely to be positive, the precise quantification will be useful for counter-factuals and extensions in general equilibrium settings.
- I am also interested in policy counter-factuals such as regulation of/subsidizing marketing of Islamic banks to reduce/increase their market shares.

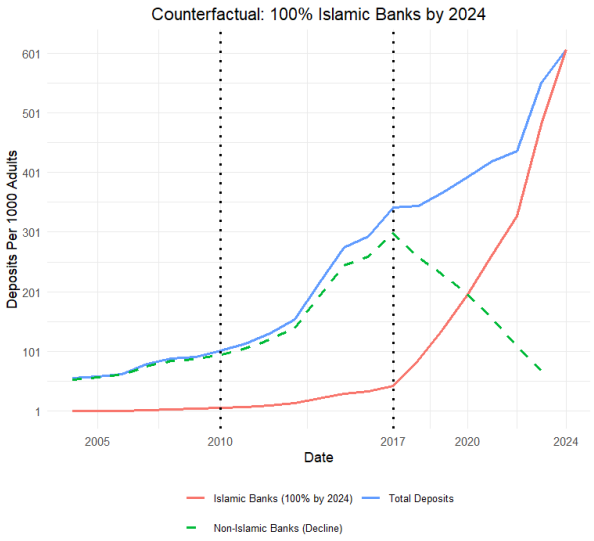
  The figures below provide a visual representation of the evolution in deposit account holders over time, relative to adult population in Pakistan. Deposit rates have increased from 10% to close to 60% during 2000 to 2025, largely driven by growth and massive rural-urban migration during this period but also due to rise of Islamic banking. In Figure 1, left, the dotted red path represents the counter-factual evolution of deposits when Islamic banks are banned and in Figure 1, right, I show that if government is able to achieve its stated goal of Islamizing the banking system, then all deposits will eventually be held in Islamic banks[8].

[7] The next section contains full details of the model. $\delta^s_{x,b}$ is time-invariant pure preference for Islamic banking versus Non-Islamic banking fro agent x; $x^\top_b$ is a set of bank-specific characteristics: location, whether your family or friends have a deposit account in any ot them, branding, past history of defaults etc, apart from the fact that it is an Islamic bank. $\alpha^s_{x,b,t}$ is wealth-elasticity, $\rho^s_{x,b}$ is risk aversion with respect to perceived volatility of interest rates and ε^s_{xbt} is noise.

[8] This is reasonable since despite the existence of minority groups such as atheists and Non-Muslims in Pakistan, deposit accounts will not be lower with only Islamic banking options, at least in any meaningful sense.



Deposit Growth and Counter-Factual 1



Deposit Growth and Counter-Factual 2

Figure 1: Source: FRED St Louis Data

Estimation of fundamental preference parameters will also allow for a more nuanced understanding of the demand side in this peculiar industry. For instance, if δ_b^s is not significantly different across bank types, it will either imply need for exorbitantly low elasticity of interest rates[9] for Islamic banks or some alternative mechanism to explain 25% market share of Islamic banking such as marketing of profit and loss sharing from non-religious angle and high *risk-aversion* of investors, allured by the perceived certainty of profit and loss sharing. Similarly, if innate preference parameter δ_b accounts for most of the variation in hitherto market shares and effects of interest rates is insignificant, Islamic banks can increase their profits by slightly increasing lending rates.

Motivation For Structural Approach

The simplest, reduced form framework to identify parameters of interest would be to estimate the following regression where msh_{bt}^s is market share for bank b in market segment s and time t:

$$ln(msh_{bt}^s) - ln(msh_{ot}^s) = x'_{b,t}\beta^s + \delta_b^s - \alpha_b^s r_{bt}^s - \rho^s \sigma^2_{r_{bt}^s} + \varepsilon_{bt}^s$$

However, even if I am able to identify the parameters of interest, a reduced-form approach does not enable me to conduct consumer welfare analysis. To conduct a con-

[9]This is because if anything, the empirical evidence suggests that interest rates are marginally higher for loans with Islamic banks.

sumer welfare analysis, I require a structural framework that endogenizes market share concentration as the outcome of competition between Islamic and conventional banks. The model will jointly specify demand across segments, pricing of loan rates and market power will emerge endogenously.

The structural framework provides an opportunity to evaluate alternative policy interventions, including increased regulatory oversight through Sharia compliance boards, tighter advertising controls by Pakistan Electronic Media Regulatory Authority (PEMRA) to limit excessive or explicit religious and sectarian appeals in banking[10]. Ultimately, I can make claims regarding the consumer welfare effects of policies and rise in Islamic banking's market power on low-income households and smaller firms who have higher innate preference for Islamic banks. Moreover, for generalizing this model in general equilibrium settings, where the welfare effects may change qualitatively, I need a strong, micro-foundation in partial equilibrium setting, only possible through a structural approach.

5. FULL MODEL

This is a BLP style Berry, 1995 demand model where banks have differentiated products, borrowing firms and households are heterogeneous and there is systematic sorting of customers into Islamic vs conventional banks. Any given firm or household chooses either the outside option or one of the banks: excludes possibility of multi-homing[11].

Outside Options: For depositors, the outside option corresponds to holding cash. For household borrowers, it represents delaying purchase of durable goods such as cars or borrowing from loan sharks in the informal sector. For firms, the outside option captures delaying investment decisions or borrowing from an international bank for large firms.

AGENT UTILITIES

For each of the agent types: depositors d, household borrowers h, and firms f, the choice is to choose bank $b \in B = (Islamic, Non - Islamic)$.

[10]Such appeals can have sensitive consequences for a social fabric, already divided by class, ethnic background and various religious denominations.

[11]Given the low level of financial access and literacy in the developing world, this is a reasonable assumption for household borrowing. In the case of high-productivity firms, the outside option can indicate borrowing from abroad. However, I do abstract from the possibility that firms can borrow from both Islamic and Non-Islamic banks due to cleaner identifying assumptions.

For consumer segments $s \in \{D^h, D^l, Hh, Hl, Fh, Fl, II, INI\}$ where Hh is high risk household borrower type, Hl is low risk household borrower, Fh is high risk firm borrower, Fl is low risk firm borrower, D^h is depositor with higher probability of withdrawal and D^l is depositor with lower probability of withdrawal. II is investment partner of Islamic bank who is highly-risk averse; INI is investment partner in Non-Islamic bank who is less risk-averse. Both banks are assumed to be risk-neutral. For agent $x \in s$ (individual agent in each of the segment), the utility specification is the following:

$$u^s_{xbt} = X'_{b,t}\beta^s_{x,b,t} + \delta^s_{x,b} - \alpha^s_{x,b,t} r^s_{bt} - \rho^s_{x,b,t} E_t \sigma^2_{r^s_b} + \varepsilon^s_{xbt} \tag{2}$$

Outside options (no bank chosen) are:

$$u^s_{x0t} = \varepsilon^s_{x0t} \quad s \in \{D^I, D^{NI}, Hh, Hl, Fh, Fl, II, INI\}$$

$X^T_{b,t}$ are bank level characteristics such as location (central location in city versus not), branding apart from Islamic appeal[12], past bank-run history, dummy variable for whether you friends or family have a bank account in the industry and initial market shares aggregated at the level of Islamic or Non-Islamic banks as of 2002. $\beta^s_{x,b}$ is corresponding vector of coefficients which can vary across consumers types, bank and individuals.

Meanwhile, $\delta^s_{x,b}$ is the common, time-invariant, utility of agent x, bank b in segment s across consumers which captures pure Islamic versus Non-Islamic effect as opposed to other differential features. $\alpha^s_{x,b,t}$ captures individual-specific wealth-elasticity, where $\alpha^s_{x,b,t} < 0$ for depositors receiving rates and $\alpha^s_{x,b,t} > 0$ for the borrowers, paying lending rates. Lastly, ε^s_{xbt} is idiosyncratic noise which has type-1, extreme value, IID distribution.

The wealth elasticity of interest rates is expected to satisfy the following conditions which can be micro-founded based on the logic that there is adverse selection of low wealth or high-risk households and smaller firms into Islamic banking. In general, households are more sensitive to rates than firms and investment partners of Islamic banks should be less sensitive to higher rates of returns on investments due to risk-aversion.

Rate Sensitivity Ordering:

$$\alpha^{Hh} > \alpha^{Hl} > \alpha^{Fh} > \alpha^{Fl} > 0 > \alpha^{II} > \alpha^{INI}$$

[12]For instance, HBL (Habib Bank Limited: Conventional bank) has a high reputation in Pakistan, sponsors the popular PSL cricket league in the country and is a major brand due to being the oldest bank of Pakistan.

Meanwhile, ordering for the degree of absolute risk-aversion: ρ_x^s across consumer types is described below; it is expected to be higher for high risk type households and firms relative to their counter-parts. In general, firms of all types are less risk-averse than households of all types. Moreover, risk-perception of investment partners of Islamic banks are more risk-averse than partners of Non-Islamic banks.

Risk Aversion Ordering:

$$\rho^{Hh} > \rho^{Hl} > \rho^{Fh} > \rho^{II} > \rho^{INI} > \rho^{Fl}$$

BLP with Consumer Heterogeneity

The equations below are fairly standard in the IO literature: Berry, 1995 and are reproduced below. The main point is that a contraction mapping is needed to estimate average structural utility: $\underbrace{\Delta_{bt}^s}_{\text{mean structural utility}}$ which is otherwise not observable even if δ, α, ρ are identified through instruments due to un-observed bank-specific features which effect utility: η_{bt}^s. Once again, this necessitates a structural approach.

$$u_{xbt}^s = X_{b,t}' \beta_{x,b,t}^s + \delta_{x,b}^s - \alpha_{x,b,t}^s r_{bt}^s - \rho_{x,b,t}^s E_t \sigma_{r_b^s}^2 + \varepsilon_{xbt}^s$$

$$u_{xbt}^s = \underbrace{\Delta_{bt}^s}_{\text{mean structural utility}} + \underbrace{\mu_{xbt}^s}_{\text{heterogeneity}} + \varepsilon_{xbt}^s$$

$$\Delta_{bt}^s = X_{b,t}' \beta_{b,t}^s + \delta_b^s - \alpha_{b,t}^s r_{bt}^s - \rho_{b,t}^s \sigma_{r_b^s}^2 + \eta_{bt}^s$$

Outside option:

$$u_{x0t}^s = \varepsilon_{x0t}^s$$

$$s_{bt}^s = \int \frac{\exp\left(\Delta_{bt}^s + \mu_{xbt}^s\right)}{1 + \sum_{j=1}^{B} \exp\left(\Delta_{jt}^s + \mu_{xjt}^s\right)} dF(x) \equiv S_b(\Delta_t^s, \theta)$$

$$\Delta_t^s = S^{-1}\left(s_t^{obs}, \theta\right)$$

Contraction Mapping Algorithm:

$$\Delta_{bt}^{s\,(k+1)} = \Delta_{bt}^{s\,(k)} + \ln\left(s_{bt}^{obs}\right) - \ln\left(S_b\left(\Delta_t^{s\,(k)}, \theta\right)\right)$$

$$\Delta_t^{s\,*} = \mathcal{T}(\Delta_t^{s\,*})$$

In this context, consumer welfare or interchangeably surplus can be defined as follows:

Consumer Welfare:

General Form:

$$\mathrm{CS}_t^s = \int \frac{1}{\alpha_x^s} \ln\left(1 + \sum_{b=1}^{B} \exp\left(\Delta_{bt}^s + \mu_{xbt}^s\right)\right) dF(\mu_x)$$

If no random coefficients exist then, a closed form solution of following form exists:

$$CS_t^s = \frac{1}{\alpha^s} \ln\left(1 + \sum_{b=1}^{B} \exp\left(\Delta_{bt}^s\right)\right) \tag{3}$$

In order to understand the long-run, partial equilibrium effects of Islamic banks' market shares, I define aggregate consumer surplus as follows:

$$CW_{PE} = \sum_{t=1}^{T} \beta^t \sum_s w_{s,t} \frac{1}{\alpha_t^s} \ln\left(1 + \sum_{b=1}^{IB_t} \exp\left(\Delta_{bt}^s\right) + \sum_{b=1}^{NIB_t} \exp\left(\Delta_{bt}^s\right)\right) \tag{4}$$

$\frac{\delta \mathbb{CW}_{PE}}{\delta IB_t} > \frac{\delta \mathbb{CW}_{PE}}{\delta NIB_t} > 0$ is expected in PE setting. My main goal is to quantify consumer welfare gains from an endogenous increase in Islamic banking options.

Debt Default Events depend on borrower or depositor types due to adverse-selection which is imperfect, indicating a positive, probability for all consumer types for all bank types. $\psi_{x,t}$ is an IID, shock which increases the probability of withdrawal and default for borrower x in segment s; this shock is not observed by the banks and is the source of uncertainty. However, in a truly, dynamic model, understanding of $\psi_{x,t}$ can improve over time as firms observe default rates and correlated demographics or sectors/features of firms, leading to *bayesian updating* over time[13]. The probability of default in sector s is given below:

[13] I can incorporate dynamic, bayesian updating in an extension of the model.

$$p_x^s() = \begin{cases} p_x^{s^h}(r_{bt}^s, \psi_{x,s,t}), & s^h \in \{Hh, Fh\}, \\ p_x^{s^l}((r_{bt}^s, \psi_{x,s,t})), & s^l \in \{Hl, Fl\}, \end{cases}$$

$$p_x^{s^{Hh}}(r_{bt}^s, \psi_{x,s,t}) > p_x^{s^{Hl}}(r_{bt}^s, \psi_{x,s,t});\ p_x^{s^{Fh}}(r_{bt}^s, \psi_{x,t}) > p_x^{s^{Fl}}(r_{bt}^s, \psi_{x,s,t})$$

$\frac{\delta p_x^{s^h}}{\delta \psi_{x,s,t}} > 0$ and $\frac{\delta p_x^{s^l}}{\delta \psi_{x,s,t}} > 0$ holds.

I choose the following logistic style functional form in the model for computation, where I abstract from individual level unobserved $\psi_{x,s,t}$ by varying $\psi_{s,t}$ only across segments. In practice, the functional form can be estimated from the data through a SMM[14] approach.

$$p_x^s(r_{bt}, \psi_{s,t}) = \begin{cases} \dfrac{\exp\left(\gamma_0^{s^h} + \gamma_1^{s^h} r_{bt} + \gamma_2^{s^h} \psi_{s,t}\right)}{1 + \exp\left(\gamma_0^{s^h} + \gamma_1^{s^h} r_{bt} + \gamma_2^{s^h} \psi_{s,t}\right)}, & s^h \in \{Hh, Fh\}, \\ \dfrac{\exp\left(\gamma_0^{s^l} + \gamma_1^{s^l} r_{bt} + \gamma_2^{s^l} \psi_{s,t}\right)}{1 + \exp\left(\gamma_0^{s^l} + \gamma_1^{s^l} r_{bt} + \gamma_2^{s^l} \psi_{s,t}\right)}, & s^l \in \{Hl, Fl\}. \end{cases}$$

$\gamma_k^{s^h} > \gamma_k^{s^l} \forall k \in 0, 1, 2.$

BANK BALANCE SHEET CONSTRAINTS

In general, the binding balance sheet constraint is of form:

$Assets = Loans + Securities + Reserves = Deposits + Bank\ Borrowing + Equity.$

The above can be expressed as the following for each bank b and time t.

$L_{bt} + BI_{bt} + Res_{bt} = D_{bt} + BB_{bt} + Eq_{bt}.$

More specifically, $q_{bt}^{Hh} + q_{bt}^{Hl} + q_{bt}^{Fh} + q_{bt}^{Fl} + Res_{bt} + BI_{bt} = q_{bt}^{D} + BB_{bt} + Eq_{bt}$, where independent bank investment is BI_{bt}, BB_{bt} is bank borrowing from either the public sector or inter-bank lending and Eq_{bt} corresponds to investment banking partner's deposits.

In the context of Pakistan, evidence Shaikh, 2016 suggests that conventional banks can have higher loan to deposit ratios, which captures superior capacity for liquidity transformation, partially due to higher international connections relative to Islamic banks. For Islamic banking as a whole, loan to deposit ratios are lower: 58% vs 68% for conventional banks Shaikh, 2016.

[14] Simulated Method of Moments.

COST FUNCTIONS

The convex cost of banking for both bank types is defined below where the cost of establishing an Islamic bank: fixed cost is higher due to Shariah compliant requirements and creation of "novel" financial ecosystems. Moreover, cost of screening loan customers is higher for Islamic banks since they are aware of adverse selection despite not perfectly identifying the actual default probability which is under-estimated. Lastly, cost of maintaining deposits is identical across the two banks due to negligible screening needed for deposits, which are almost always welcome as bank assets due to fractional reserve banking.

Islamic bank:

$$C_{bt}^{I} = F_I + \left(\frac{c_I^D}{2}\right)^2 q_{bt}^D + \sum_{s\in\{Hh,Hl,Fh,Fl\}} \left(\frac{c_I^s}{2}\right)^2 q_{bt}^s$$

Non-Islamic bank:

$$C_{bt}^{NI} = F_{NI} + \left(\frac{c_{NI}^D}{2}\right)^2 q_{bt}^D + \sum_{s\in\{Hh,Hl,Fh,Fl\}} \left(\frac{c_{NI}^s}{2}\right)^2 q_{bt}^s$$

Deposits entail identical processing costs across bank types,

$$c_I^D = c_{NI}^D, \qquad D \in \{Dh, Dl, II, INI\}$$

$$c_I^s > c_{NI}^s \qquad s \in \{Hh, Hl, Fh, Fl\}$$

STOCHASTIC INVESTMENT RETURNS

There are two investment options available to both risk-neutral bank-types which evolve as per law of motions stated below. Non-Islamic banks will invest only in A_H sector, conditional on the information about stationary distribution of investment. Meanwhile, Islamic banks will choose to invest only in A_L, conditional on information at time 0. However, when new information is revealed over time about lower return realizations in any of the two choices, Islamic banks can make adjustments only with a lag, but conventional banks can quickly re-adjust investment strategies due to lack of profit and loss sharing

contract driven rigidity.

In reality, A_H sector can include multiple sectors such as financial innovation, export-intensive software industry and venture capital for start-ups. Meanwhile, A_L can include investing in corporate sector, sugar and textile industry. In fact, evidence exists that investments are biased against financial innovation (1.6 versus 7.1%) and SMEs (2.1 vs 4.9%) in Islamic banks.

$$I(q) = Aq^{\alpha}, \quad \alpha \in (0,1)$$

where there are two possible set of ventures possible:

$$A_H(t) = \exp\Big(\mu_H + \rho_H \log A_H(t-1) + \sigma_H \epsilon_H(t)\Big), \qquad \epsilon_H(t) \sim N(0,1)$$
$$A_L(t) = \exp\Big(\mu_L + \rho_L \log A_L(t-1) + \sigma_L \epsilon_L(t)\Big), \qquad \epsilon_L(t) \sim N(0,1)$$

$$\mu_H > \mu_L, \quad \sigma_H > \sigma_L$$

BANK PROFITS

Non-Islamic Bank:

Non-Islamic banks are risk-neutral agents and maximize the following profit function, by choosing interest/ deposit rates to offer and investment portfolio choice, given knowledge of consumer preferences, investment returns and borrower/depositor characteristics at tie t.

The static choice problem for the conventional bank is as follows subject to balance sheet constraint and information set a time t.

$$\max_{\{r_t^S, \kappa_t\}} E_t[\pi^{NI}]$$

where:

$$E_t[\pi_t^I] = E_t \begin{bmatrix} \sum_{s \neq D} (1 - p_t^s(r_t^s, \psi_t)) r_t^s q_t^s \\ + \Big(I_H(\kappa_t q^{INI}) + I_L((1-\kappa_t) q^{INI}) \Big) \\ - r_t^D q_t^D - C_t^I \end{bmatrix}$$

subject to:

$$\sum_s q_t^s \leq q_t^D + q_t^{INI}, \; \kappa_t \in [0,1]$$

, Information Set and Reserve Requirements.

The optimal portfolio choice can be micro-founded (refer to appendix 9) using CRRA preferences and logit choice with type-1 extreme value distributions, where $\lambda_{NIB} = 1$ to normalize risk-aversion parameter.

$$\kappa_t^{NIB} = \frac{1}{1 + \exp\left(-\frac{\log A_H^t - \log A_L^t}{\lambda_{NIB}}\right)} \tag{5}$$

There is no moral hazard here since Non-Islamic bank is risk-neutral and the investor is less-risk averse such that he accepts any level of investment on high-return, high-risk assets.

Islamic Bank:

In Islamic banks, r_{bt}^D denotes profit-and-loss sharing returns to depositors and is typically small, while $r_{bt}^{s,I}$ are lending rates agreed upon with borrowers. Investment choice: $\kappa_t \in (0,1)$, the share allocated to high-risk, high-return versus low-risk, low-return projects has to be made as well. Although Islamic banks are also risk-neutral and would prefer $\kappa_t = 1$ in general, investors' risk aversion and moral hazard considerations imply an interior optimum $\kappa_t \in (0,1)$, often above 0 due to asymmetric information in favor of bank. The optimal κ_t depends on investors' risk aversion and the bank's ability to conceal information[15]; PLS_{bt} represents a perfectly enforced, exogenous profit-and-loss sharing contract: e.g. $PLS_{bt} = 75\%$ for instance if bank keeps majority of investment return share, a return for their investment acumen.

$$\max_{\{r_t^s, \kappa_t\}} E_t[\pi_t^I]$$

[15] $\kappa = 1$ (unconditionally) if banks can perfectly conceal all information. $\kappa = 0$ (unconditionally) if no information can be hidden from investment partner.

$$E_t[\pi_t^I] = E_t \begin{bmatrix} \sum_{s \neq D} (1 - p_t^s(r_t^s, \psi_t)) r_t^s q_t^s \\ +PLS_t\Big(I_H(\kappa_{t|t} q_t^{II}) + I_L((1-\kappa_{t|t}) q_t^{II})\Big) \\ -r_t^D q_t^D - C_t^I \end{bmatrix}$$

Subject to:

$$\sum_s q_t^s \leq q_t^D + q_t^I;\ \kappa_t \in [0,1]$$

, Reserve Requirements, Degree of Information Asymmetry, Information about investment market returns.

Choice of κ_t is given below (refer to appendix 9). The friction in investment re-allocation will be driven by the *effective*[16] risk-aversion parameter: $\lambda_{IB} > 1$. $\kappa_t^{IB} - 0$ is the measure of moral hazard for Islamic banks, which is an endogenous model object.

$$\kappa_t^{IB} = \frac{1}{1 + \exp\left(-\frac{\log A_H(t) - \log A_L(t)}{\lambda_{IB}}\right)} \tag{6}$$

POLICY TRANSMISSION: TAYLOR RULE

This will not play a major role in this model, since this is not a New Keynesian, DSGE model; however, I will use monetary policy shock identification techniques to identify η_t which will effect equilibrium rates charged by banks. Primarily, I will use central governor turnover dates, IMF debt-rollover agreements and State Bank of Pakistan's press releases to identify the monetary policy shock.

$i_t = r^* + \pi^* + \phi_\pi(\pi_t - \pi^*) + \phi_y(y_t - y^*) + \eta_t$

Ultimately, $r_{bt}^s = r_{bt^*}^s + \tau_b(i_t)$, where $r_{bt^*}^s$ is chosen by banks for various lender segments and $\tau_b(i_t)$ is capturing the transmission of policy rates into loan rates for banks; this function can vary across $b \in (I, NI)$ due to lower degree of integration with conventional monetary transmission channels for Islamic banking sector.

[16] In reality, $\lambda_{IB} = \infty$ but $\lambda_{IB} < \infty$ is possible in practice due to asymmetric information. This can be micro-founded by using a standard model of signaling in games of asymmetric information.

6. Data and Identification

I will use quarterly data from the Banking Surveillance Department (BSD), State Bank of Pakistan (SBP), specifically the QPR (Quarterly Performance Review) data set available via https://www.sbp.org.pk/publications/q_reviews/old-qpr.htm at quarterly level from 2002 to 2025: State Bank of Pakistan, 2024. The QPR provides detailed bank-type level information on balance sheet items: deposits, operating costs, loan disbursements by sector and defaults, dis-aggregated by Islamic versus Non-Islamic banks. I will also use HIES data: Statistics, 2024–25 household survey data to measure demographic covariates associated with financial inclusion.

Data for r^s_{bt}: loan or deposit rates can be accessed via IMF and Fred St Louis data sources. For instance, in 2025, HBL launched fixed mark-up rate on car loans: 9.99% for salaried and self-employed individuals. Meanwhile, Islamic banks have fixed, Riba-free rates starting from around 11.83% (1-year) to 12.24% (6-year loans) on car loans. Similarly, data on bank entry dates for Islamic banks is also available online.

The monetary policy shock η_t will be identified by using event study methodology explained below.

The key parameters to be identified and corresponding identification strategies are described below:

Instruments, Identification and Parameter Estimates

- **Default Probabilities** p^s: I will use NPL (Non-Performing Loans data) from QPR[17] to measure default probabilities for loans across Islamic and Non-Islamic banks and product types: consumer loans and firms etc. In general, the evidence suggests that default probabilities are lower for Islamic banks.

- **Bank Type Preference** δ^s_b: I will use Islamic bank launch timing to identify this parameter: initial variation approach. For instance, Meezan Bank, a Islamic bank, was fully commercial in 2002 but HBL has existed since 1947 in Pakistan. Data on market share acceleration will be used to determine which time range is appropriate: for instance the data suggests that 2002 to 2010 is appropriate choice since the 2010 flood

[17]The QPR: Quarterly Performance Review from State Bank of Pakistan provides data on NPLs: Non-performing loans defined as bank advances or loans where the interest or principal payment is overdue by 90 days or more: measure of defaults.

shock led to significant rural to urban migration and a regime switch in deposit rate accumulation.

- **Price Sensitivity** α_{bts}: I will use exogenous variation driven by monetary policy shocks to identify α_{bts}. The monetary policy shock: η_t will be identified using event studies: governor turnover dates, State Bank's communication events and policy briefs with the public during 2002-2025.

- **Risk-Perception**: ρ_{st}, the risk perception will be identified using exogenous macroeconomic uncertainty shocks: war and terrorism events, floods and other disasters; these are related to perceived risk aversion regarding the banking system. This is related to the second moment of interest rates, conditional on effect of first moment of interest rates.

- **Cost Parameters** c_I^s, $c_N I^s, c^D$: To this end, I will use observed administrative expenses from bank balance sheet data from State Bank of Pakistan's QPR reports for Islamic versus Non-Islamic banks.

- **Adverse Selection**: Data on quantity of loans across lender types: $q_{bt}^{Hh}, q_{bt}^{Hl}, q_{bt}^{Fh}, q_{bt}^{Fl}$ across $b \in (I, NI)$ types can be used from balance sheet data, available from QPR. It is challenging to measure adverse selection since prima facie evidence suggests that default rates are actually lower for Islamic banks which is likely to be a function of their restricted loan acceptances and stronger screening. Ideally, I need data on loan *applicants* and *approvals* for all banks and across all sectors which is confidential information. Such a data set exists: eCIB: (SBP) Electronic Credit Information Bureau: loan origination dates, maturity dates, product types and demographic data.

- **Moral Hazard**: $\kappa_t^{IB} - 0$ is an endogenous object of the model. Empirically, any deviation of investment portfolios away from 0 share in high-risk, high-return investments is moral hazard since with perfect information sharing, $\kappa_t^{IB} = 0$. Data on investment portfolios across the bank types is available from State Bank of Pakistan, 2025 to identify this.

7. Parameters For Simulation

I used the following parameterization for simulation (Table 1 and 2): borrower preference parameters and bank-specific parameters.

Table 1: Borrower-Specific Parameters

Parameter	Hh	Hl	Fh	Fl
Bank Preference Parameters				
δ_I	2.0	0.0	0.4	0.0
δ_{NI}	0.0	0.5	0.0	0.4
Interest Rate Sensitivity				
α_I	5.0	6.0	5.0	6.0
α_{NI}	5.5	6.0	5.5	6.0
Risk Perception Parameters				
ρ_I	0.5	0.1	0.5	0.0
ρ_{NI}	1.0	0.1	1.0	0.0
Default Probability Parameters				
γ_0	-1.5	-5.0	-1.5	-6.0
γ_1	6.0	3.0	5.0	2.5

Table 2: Bank-Level Parameters

Parameter	Islamic Bank	Non-Islamic Bank
Portfolio Choice Parameters		
Effective (Real) Investment Partner Risk Aversion:	5.0 (∞)	1.0 (1.0)
Technology Shock Process		
Persistence (high) ρ_H	0.3	
Persistence (low) ρ_L	0.95	
Volatility (high) σ_H	0.5	
Volatility (low) σ_L	0.2	
Mean (high) μ_H	0.5	
Mean (low) μ_L	0.25	

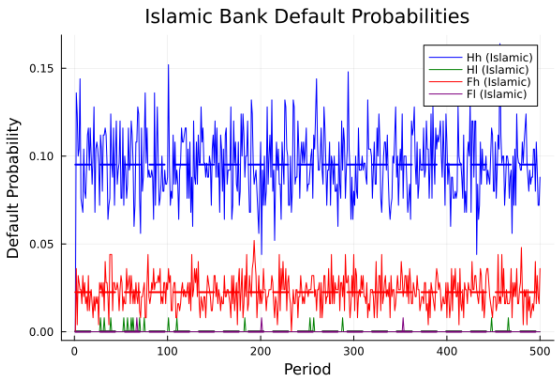
8. SIMULATION RESULTS

The results show that despite adverse selection, default rates for high risk firms and households are lower for Islamic bank lenders versus Non-Islamic banks (Figure 2: a and b), consistent with evidence from State Bank of Pakistan. This is despite the fact that Islamic banks are likely to face high-risk consumers and is reflective of their highly selective screening for loans, leading to lower loan creation.

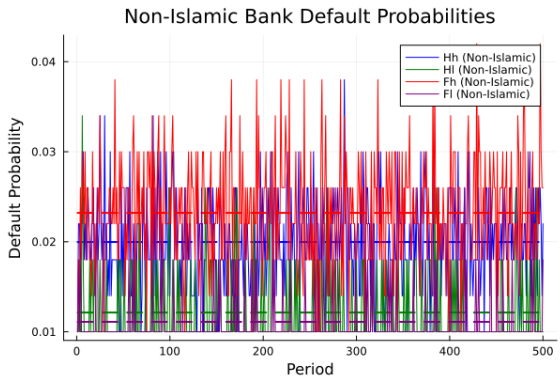
Moreover, Figure 3 (c) reveals the investment banking operations of conventional banks create higher volatility and higher average returns relative to Islamic banks. This is true, despite the fact that Islamic bank's prefer $\kappa = 1$ (on average or unconditionally), indicating exactly the same level of desired volatility and returns as for conventional banks. The

wedge is created by the fact that investments by Islamic banks are constrained by rigid and sticky contractual obligations with investment partners who are risk-averse.

Lastly, consistent with empirical evidence, firm/household lending rates vary across the two bank types: refer to Figure 4 below. Consistent with empirical evidence, this model can explain why lending rates are slightly higher for Islamic banks, specially for high-risk type households and firms. These rates are able to sustain themselves in equilibrium due to innate preference for Islamic banks which is higher for high-risk types and higher risk-aversion of investors in Islamic banking.

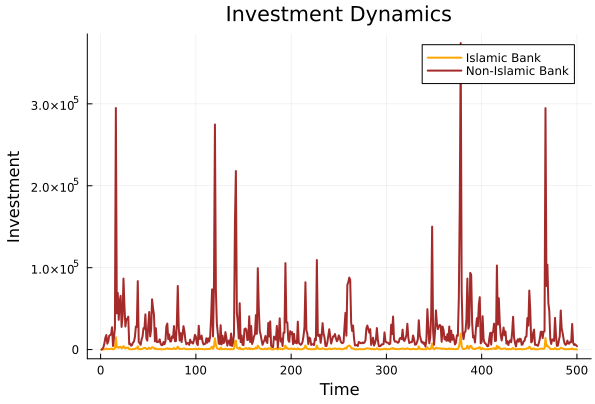


(a) Islamic Default Rates

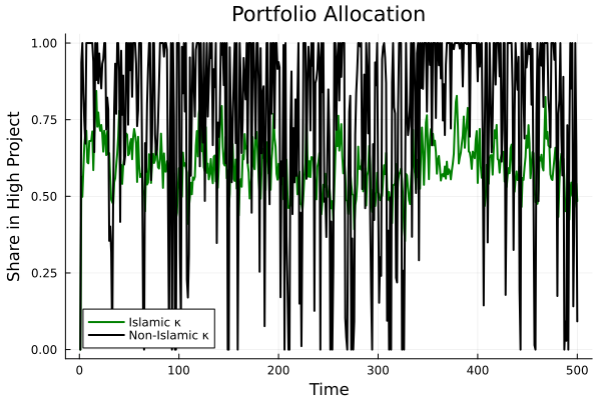


(b) Non-Islamic Defaults

Figure 2: Simulation results over T periods: Default Rates.

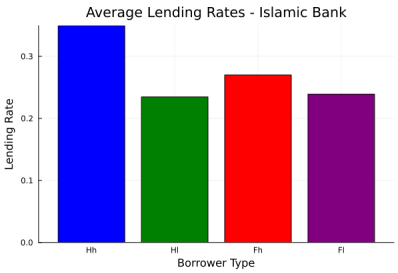


(c) Investment Returns over T periods

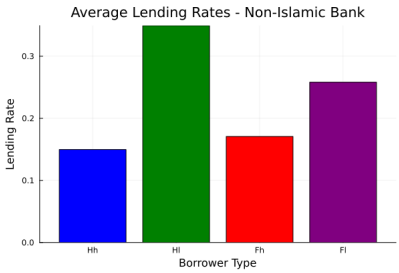


(d) Portfolio Allocation: κ_t over T periods

Figure 3: Simulation results over T periods: investment and kappa dynamics.



(a) Lending Rates: Islamic



(b) Lending Rates: non-Islamic

Figure 4: Simulation results over T periods. Each panel shows a different measure of bank performance.

Consumer Surplus and Counter-Factuals:

I estimate consumer surplus using $\beta = 0.99$ and $T = 500$. With both Islamic and Non-Islamic banks in the market, aggregate, discounted consumer surplus is estimated to be 2.25 billion Pakistani rupees out of which 1.06 billion is consumer surplus driven by Non-Islamic bank. However, if I consider the policy counter-factual with two Non-Islamic banks (if Islamic banks are banned) and assume that same loan rates will prevail as with one Islamic and one Non-Islamic bank, the consumer surplus is 2.12 billion, suggesting that consumers will be marginally better off with a combination of Islamic and Non-Islamic banks. Thus, in counter-factual terms, value of Islamic banks for all consumers combined in present-discounted terms is $2.25 - 2.12 = 0.13$ billion rupees.

While many consumers prefer Islamic banking, counter-factual with more conventional banks is only *marginally* less optimal for welfare than default with combination of bank types. If loan rates can be reduced by entry of more conventional banks, relative to more Islamic bank entry, the surplus can become higher with more conventional bank entry even in partial equilibrium. Lastly, even if I accept the questionable result that Islamic banks adds value of $2.25 - 1.06 = 1.2\, billion$ rupees (consumer welfare without counter-factual), this is merely a partial equilibrium effect.

Moreover, this is an aggregate consumer welfare; decomposition across consumer types can yield insights about whether high-risk households and high-risk firms benefit from Islamic banks or not. Total high risk borrower surplus (firms and households of high-risk) is 0.22 billion of which 0.03 billion (15%) is attributable to Non-Islamic bank. Lastly, in counter-factual with two Non-Islamic banks, consumer surplus for high-risk borrower types is only 30% of 0.22 billion rupees. In other words, as expected the counter-factual surplus for high-risk borrowers is positive and significant in statistical terms. Neverthe-

less, in general equilibrium, the magnitudes and direction can change.

$$\mathbb{CW}_{PE} = \sum_{t=1}^{T} \beta^t \sum_s w_{s,t} \frac{1}{\alpha^s} \ln \left(1 + \sum_{b=1}^{IB_t} \exp\left(\Delta_{bt}^s\right) + \sum_{b=1}^{NIB_t} \exp\left(\Delta_{bt}^s\right) \right) = 2.2 \, billion \, ruppees$$

9. CONCLUSION

This work develops a partial equilibrium model of consumer choice between Islamic and Non-Islamic banks and studies how bank composition affects aggregate consumer welfare. Using a Monte Carlo simulation with borrower heterogeneity, risk-sensitive preferences, and stochastic investment returns, I find that while many consumers exhibit a preference for Islamic banks, the overall contribution of Islamic banks to aggregate consumer surplus is relatively modest in a partial equilibrium setting. Counterfactual simulations reveal that replacing an Islamic bank with an additional Non-Islamic bank can moderately reduce aggregate consumer surplus, when loan rates are held fixed.

While the model captures key aspects of borrower heterogeneity, bank-specific preferences, and stochastic investment returns, it is limited to a partial equilibrium framework. Future work could extend the analysis to a general equilibrium setting, allowing for dynamic entry and exit of banks, and feedback between bank portfolio decisions and aggregate economic outcomes such as growth and business cycle fluctuations. Additionally, incorporating explicit dynamic borrower-bank relationships would provide a richer understanding of how Islamic and conventional banks contribute to long-term consumer welfare. These extensions would help evaluate whether the observed welfare results persist once relationships and risks are fully internalized.

10. APPENDIX: PORTFOLIO CHOICE

This section provides the micro-foundation for portfolio allocation rule used in the simulation.

10.1. ENVIRONMENT

Banks allocates total investment across two technologies:

- A high-return (risky) technology with productivity $A_{H,t}$
- A low-return (safe) technology with productivity $A_{L,t}$

Let $\kappa_t \in [0, 1]$ denote the share of funds allocated to the high-return technology. Total investment is normalized, so the remaining share $1 - \kappa_t$ is allocated to the low-return technology.

10.2. RANDOM UTILITY FOUNDATION

The bank evaluates the two technologies according to:

$U_{H,t} = logA_{H,t} + \varepsilon_{H,t}$ and $U_{L,t} = \log A_{L,t} + \varepsilon_{L,t}$.

where $\varepsilon_{H,t}$ and $\varepsilon_{L,t}$ are i.i.d. Type-I extreme value shocks.

The bank chooses high-return technology if $U_{H,t} > U_{L,t}$. The implied probability of choosing the high-return technology is given by logit formula:

$$\kappa_t^* = \Pr(U_{H,t} > U_{L,t}) = \frac{1}{1 + \exp\left(-\frac{\log A_{H,t} - \log A_{L,t}}{\gamma_b}\right)}, \tag{7}$$

where $\gamma_b > 0$ is a bank-specific parameter governing sensitivity to return differences.

The parameter γ_b can be interpreted as a reduced-form measure of risk aversion. A higher value of γ_b dampens the response of portfolio allocation to return differentials, leading to more diversified and stable investment behavior. Banks differ in their portfolio choice behavior via variation in γ_b.

11. APPENDIX: LIKELIHOOD FUNCTIONS

11.1. CHOICE PROBABILITIES

Let n_{bts} denote the number of borrowers of type s choosing bank $b \in I, NI$ at time t, and n_{0ts} the number choosing the outside option.

Borrowers choose among three alternatives: Islamic bank (I), non-Islamic bank (NI), and the outside option (0). Choice probabilities follow a multinomial logit model:

$$P_{bts} = \frac{\exp(U_{bts})}{1 + \exp(U_{Its}) + \exp(U_{NIts})}, \quad P_{0ts} = \frac{1}{1 + \exp(U_{Its}) + \exp(U_{NIts})} \tag{8}$$

where indirect utility is given by:

$$U_{bts} = \delta_b^s - \alpha_b^s r_{bt}^s - \rho_b^s \sigma_b \tag{9}$$

The likelihood contribution from choices is:

$$\mathcal{L}_{ts}^{\text{choice}} = P_{Its}^{n_{Its}} \; P_{NIts}^{n_{NIts}} \; P_{0ts}^{n_{0ts}} \tag{10}$$

11.2. DEFAULT PROCESS

Default probabilities follow a logit specification:

$$p_{bts}^{\text{def}} = \frac{\exp\left(\gamma_0^s + \gamma_1^s r_{bt}^s\right)}{1 + \exp\left(\gamma_0^s + \gamma_1^s r_{bt}^s\right)} \tag{11}$$

For Islamic banks, default risk is lower due to institutional features such as more strict rules regarding acceptance of loans.

Let q_{bts} denote the number of loans issued to type s at bank b, and d_{bts} the number of defaults. Defaults follow a binomial distribution:

$$d_{bts} \sim \text{Binomial}(q_{bts}, p_{bts}^{\text{def}}) \tag{12}$$

The likelihood contribution from defaults is:

$$\mathcal{L}_{bts}^{\text{def}} = \binom{q_{bts}}{d_{bts}} \left(p_{bts}^{\text{def}}\right)^{d_{bts}} \left(1 - p_{bts}^{\text{def}}\right)^{q_{bts} - d_{bts}} \tag{13}$$

11.3. Total Likelihood

The full likelihood across time, borrower types, and banks is:

$$\mathcal{L}(\Theta) = \prod_{t} \prod_{s \in \{Hh,Hl,Fh,Fl\}} \left[\mathcal{L}_{ts}^{\text{choice}} \cdot \prod_{b \in \{I,NI\}} \mathcal{L}_{bts}^{\text{def}} \right] \tag{14}$$

where the parameter vector for consumer side is:

$$\Theta = (\delta_b^s, \alpha_b^s, \rho_b^s, \sigma_b^s, \gamma_0^s, \gamma_1^s) \tag{15}$$

12. Appendix: Bank Classification in Pakistan

The table below displays names of some major, prominent conventional banks: e.g. HBL, the largest bank in Pakistan and Islamic banks: e.g. Meezan bank, the largest Islamic bank. For a more exhaustive list of Islamic banks and their regional variation in Pakistan refer to State Bank of Pakistan, 2025.

Conventional Banks	**Islamic Banks**
Habib Bank Limited (HBL)	Meezan Bank
United Bank Limited (UBL)	Bank Islami Pakistan Limed
Allied Bank Limited (ABL)	Dubai Islamic Bank Pakistan
MCB Bank Limited	Al Baraka Bank Pakistan
Standard Chartered Bank (Pakistan)	Faysal Bank (Islamic window)
Bank Alfalah	Burj Bank Limited
National Bank of Pakistan (NBP)	MCB Islamic Bank Limited

The tables below outlines descriptions of some prominent products of Islamic banks such as Ijarah: a car or house loan, Salam financing: a forward-sale or Islamic future contract and Qarz-e-Hasna: interest-free loans for welfare purposes.

Instrument	Description
Murabahah	Cost-plus financing: bank buys a good and sells to client at a pre-agreed markup.
Ijarah	Leasing: bank leases an asset to client; ownership may remain with bank.
Musharaka	Partnership: bank and client contribute capital and share profits/losses.
Salam Financing	Forward sale: bank pays in advance for goods delivered in the future, often used in agriculture.
Istisna	Manufacturing/Construction contract: bank finances production or construction with delivery later.
Qarz-e-Hasna	Benevolent loan: interest-free loan given for welfare purposes or to assist someone in need.
Mudarabah	Profit-sharing: one party provides capital, other provides management; profits shared, losses borne by capital provider.

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