STRENGTHENING JUDICIAL INDEPENDENCE: A DATA-DRIVEN APPROACH TO LEGAL, ECONOMIC, AND ETHICAL COMPETENCY

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ABSTRACT

This research explores the impact of economic reasoning ability on the quality of legal reasoning and judicial rationality demonstrated by District and Sessions Court Judges in Pakistan. It aims to provide empirical evidence regarding the impact of economic skills on the decision-making of judges. It collected data from 200 judges in order to test correlational relationships between economic reasoning, legal reasoning, and judicial rationality. It also administered treatment in the form of economic skills training to determine the existence of a causal impact on judicial rationality. The results show a significant correlational relationship between the variables. The results also show a positive impact of economic skills training on the judicial rationality of participants.

PREFACE

This research was made possible with the funding and support of the RASTA Competitive Grants Program, administered by the Pakistan Institute of Development Economics (PIDE) and the Ministry of Planning, Development, and Special Initiatives. The research team is also grateful to the Sindh Judicial Academy for facilitating and enabling the training.

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INTRODUCTION

Most cases arising in Pakistan go through District and Sessions Courts, in either a trial or appellate capacity. Concurrently, Sessions Courts try heinous offences and can award the death penalty, whereas District Courts have unlimited pecuniary jurisdiction regarding the settlement of civil disputes. This leads to District and Sessions Judges frequently handling cases that involve the application of economic reasoning, in the calculation and award of remedies for both civil and criminal cases. They also adjudicate on matters that have economic implications, such as commercial disputes, taxation, and regulatory matters.

Despite the multiple commercial and financial consequences of legal proceedings, judges in Pakistan do not go through specialized economic training. Courts are unable to account for the costs of litigation, the economic impact of judicial decisions, or the award of appropriate remedies, thus dealing a heavy blow to both the economy and rule of law (Haque, 2024).

The application of economic reasoning by judges would mitigate these impacts by ensuring that judges are equipped with the necessary tools to evaluate the economic impacts of their decisions (Kayani, 2022). In recognition of this, the application of economic reasoning in law is used extensively throughout jurisdictions in the USA to ensure that judges are equipped with the necessary reasoning skills to make decisions. This study aims to gauge the effectiveness of a similar approach utilized for the capacity-building and training of judges in Pakistan.

Investigating judicial capacity in Pakistan poses several challenges. The central challenge is the identification of a metric that can reliably indicate the reasoning abilities of judges. Furthermore, judicial reasoning is impacted by a multitude of environmental and information factors, including political constraints, precedence, unconscious biases, and even gastronomy (Tampubolon et al, 2023; Liu, 2024). In order to successfully assess decision making ability, key composite indicators of judicial reasoning must be isolated and assessed using a standardized and unbiased metric. Additionally, any experimental instrument used may contain weak items or flaws that bias the data collected.

The research strategy employed in this study offers several advantages and mitigates the above-mentioned challenges. The study consists of a field experiment conducted through blind sampling at a Pakistani judicial academy, mitigating selection bias and any difficulties in obtaining a moderate sample size. This is key in ensuring the generalizability of findings to the Pakistani judge population. Experimental instruments in the form of multiple-choice tests were designed to ensure standardization of data and reliably indicate the judicial reasoning metric. The three key indicators of economic reasoning, legal reasoning, and judicial rationality were isolated and operationalized, based on available literature. Lastly, the experimental instruments were based on an Item Response Theory model. This mitigated the potential complications of a biased or flawed experimental instrument, as IRT models can identify weak test items that do not reliably indicate the abilities of the participants. The exclusion of any identified weak items contributes to the validity of the study.

The research consisted of a field experiment conducted through a training offered at a Pakistani judicial academy. Serving District and Sessions Judges from a province in Pakistan were selected to undergo training. The research design is bi-phase. In phase one, prior to the commencement of the training, participants underwent a standardized multiple-choice questionnaire (Test 1) to assess

their economic reasoning and legal reasoning abilities. In phase two, half of the participants (Group A) were given Test 2 assessing judicial rationality to complete prior to receiving training (Test 2A). After the administration of the experiment instruments, participants underwent a two-day training in economic reasoning principles of relevance to judges. After the completion of the training, the remaining participants (Group B) were given Test 2 to complete (Test 2B).

The data collected from the training was analysed, and a positive correlation was established between economic reasoning and legal reasoning scores. Judges who exhibit better economic reasoning also exhibit better legal reasoning. The data did not establish a significant causal relationship between economic reasoning and judicial rationality scores, although there was a nominal improvement in scores between Test 2A and Test 2B. Additionally, the research findings establish a positive correlation between economic reasoning, legal reasoning, and judicial rationality. The correlation between economic reasoning and judicial rationality is stronger than the correlation between legal reasoning and judicial rationality.

The research findings have significant policy and research implications. They provide generalizable evidence asserting that improvements in a judge's economic abilities have a positive impact on the quality of their judicial decision-making. The findings can be used to streamline judicial and legal training and improve the quality of commercial adjudication in Pakistan.

LITERATURE REVIEW

Recent studies in the field show that targeted trainings in economics help judges make more informed decisions, thus improving judicial efficacy. Judges who attended economic trainings offered by the Manne Economics Institute for Federal Judges after the law-and-economics movement in the USA, showed significant behavioural shifts, such as ruling against regulatory agencies more often, imposing more severe criminal sentences and using more economic analysis in their judgements (Ash et al., 2026).

Between 1976 and 1999, nearly half of all U.S. federal judges attended the Manne Institute's economics seminars. By imparting core microeconomic principles and analytic tools, these seminars sought to improve judges' economic reasoning on the bench. Research indicates this training had measurable impacts on judicial decision-making. Ash et al. (2026) conducted a quantitative analysis of U.S. judicial opinions and found that after attending the Manne economics program, judges used more economics terminology in their rulings and exhibited shifted case outcomes. These findings suggest that exposure to economic reasoning not only enriches the analytical framework of judges but can also subtly influence their ideology or policy outlook in cases with economic dimensions. The key point is that economic training fundamentally changes how judges evaluate evidence and legal trade-offs. It can lead to more rigorous analysis of efficiency, incentives, and impacts – a form of "better reasoning" even if the normative outcomes are debated. In the realm of complex business litigation, for instance, judges with economics training may be more adept at parsing expert economic testimony and assessing monopoly claims or damages models, resulting in decisions that are more analytically sound. Empirical work by Baye & Wright (2011) bolsters this view: examining 714 U.S. antitrust cases from 1996–2006, they found that judges who had attended economics courses (through the George Mason University Law & Economics Center) had significantly lower appeal rates on their decisions. The assumption is that a lower reversal/appeal rate reflects higher-quality trial decisions, so the economics-trained judges were arguably delivering more legally sound and well-reasoned judgments in complex antitrust cases.

Notably, Baye & Wright (2011) controlled for judges' prior experience and political affiliation and still found the training effect persistent; in fact, they conclude that "on the job training" (i.e. learning by years of judicial experience alone) was not as effective as formal economics education in improving performance. This evidence directly supports the notion that strengthening judges' economic reasoning skills can enhance judicial competence and outcome quality. In turn, this demonstrates how economic trainings can influence judicial behaviour, highlighting the importance of equipping judges with economic reasoning skills to improve legal outcomes, particularly in jurisdictions like Pakistan where formal trainings like these remain limited.

Importantly, the push for economic reasoning in judging is not confined to the United States. Other jurisdictions have also integrated economics into judicial capacity-building. In Europe, both the EU Commission and judicial training networks have funded programs to deepen judges' understanding of economics in competition and regulatory cases. For example, the European Commission sponsors seminars via the European Judicial Training Network and the Academy of European Law that provide national judges with training in basic economic concepts relevant to EU competition law enforcement

(UNCTAD, 2013). The objective is to ensure judges can competently evaluate matters like market dominance, anticompetitive agreements, and economic evidence presented by expert witnesses. Likewise, the United Nations Conference on Trade and Development (UNCTAD) has run workshops for judges in developing countries (e.g. a Nicaraguan judges' training in 2013) explicitly to *"familiarize High Court and Supreme Court judges with the economics underpinning national competition laws and how this combines with the legal approach to enforcing competition policy"*. These efforts stem from the recognition that without economic reasoning skills, judges may misapply competition statutes or fail to appreciate the real-world market impact of their rulings. In short, there is a growing literature demonstrating that judicial economic training can strengthen judges' analytical toolkits, leading to decisions that are more consistent, predictable, and grounded in an understanding of societal costs and benefits.

Further contextualizing the challenges confronting Pakistan's judiciary, recent studies reveal how judicial independence is significantly compromised by external factors. 'Judicial capture' through government inducements, for example, has been linked to pro-government rulings and fewer merit-based decisions, directly undermining impartial adjudication (Mehmood & Ali, 2024). Similarly, certain judicial appointment methods, such as those involving strong executive influence, can foster patronage and bias, further eroding the capacity for independent judicial action (Mehmood, 2022). While these documented external pressures and structural elements pose considerable threats to judicial integrity, this research aims to strengthen judicial independence from within. By enhancing core competencies in economic, legal, and ethical reasoning, the study seeks to improve judges' capacity for principled, evidence-based decision-making, leading to a stronger and more independent judiciary.

Existing research recognises that decisions in areas like antitrust, financial regulation, and damages awards often hinge on economic concepts (e.g. market power, cost-benefit analysis), yet traditionally few judges have formal economics training (Klick, 2018). At the same time there is research indicating that application of economic reasoning by Judges would mitigate negative or under informed decisions by ensuring that judges are equipped with the necessary tools to evaluate the economic impacts of their decisions (Kayani, 2022). Furthermore, the development of economic reasoning skill amongst judges has been tied to improvements in judicial decision making, such as constitutional interpretation and ethical judgement (Pritchard & Zywicki, 1999; Schelling, 1981).

Most research evaluating judicial decision-making encounters two significant setbacks. Firstly, it is difficult to scientifically evaluate the correctness of a judicial decision. A judicial decision takes several factors into consideration, including binding and persuasive precedent, legal developments, facts of the case, and procedural concerns. A blanket metric for evaluating correctness would lead to absurd outcomes.

Secondly, it is difficult to develop relevant indicators regarding judicial decision-making. Attempts have been made to evaluate judicial systems through data related to 'surface values' of legal systems, such as clearance rate, number of judges, or performance measures. These attempts have faced widespread criticism, as they focus primarily on 'efficiency' instead of justice, and can be easily manipulated (Posner, 2008). Instead, focus has shifted to qualitative determinations of the reasoning

ability displayed in a judgement. A judge's reasoning ability is considered of higher quality if it demonstrates clarity, transparency, and rationality (Bencze, 2018). This characteristic is also known as 'judicial rationality' (Golecki, 2018). This is separate from the 'correctness' of the judgement or its social and cultural impact, in that it only measures whether a judge has consciously and rationally deliberated their reasoning, and as communicated it to all parties in a clear and transparent manner. Combined, the rationality of a decision and its valid legal basis form the cornerstone of a judges reasoning ability.

RESEARCH METHODOLOGY

The existing literature establishes the following: (i) that knowledge about economics can inform judicial decision-making by giving judges a clearer understanding of the social and commercial impact of their judgements, and (ii) the use of 'surface value' indicators is insufficient for evaluating the quality of decision-making. This research seeks to make pioneering contributions to judicial research in Pakistan by evaluating the usefulness of economics in improving judicial performance in Pakistan.

For this purpose, the research identifies the variables of 'economic reasoning', 'legal reasoning', and 'judicial rationality'. Economic reasoning refers to a judge's ability to able economic concepts in judgements. Legal reasoning refers to the judge's application of relevant law to their judgements. Judicial rationality indicates the quality of reasoning used by judges, which may improve or deteriorate following the manipulation of economic reasoning.

3.1. Research Questions

The research seeks to identify the relationships between these three variables. It does so through the following research questions:

1. Do high levels of competence in economic reasoning correlate with high levels of legal reasoning in judges?
2. Does improved economic reasoning improve judicial rationality?
3. Do high levels of competence in economic reasoning correlate with high levels of judicial rationality?

The first question examines the existence of a correlational relationship between economic reasoning and legal reasoning. The correlational variables are economic reasoning and legal reasoning. Based on the available literature, a positive correlation is hypothesised.

The second research question examines the existence of a causal relationship between economic reasoning and judicial rationality. Economic reasoning is posited as the independent variable, and judicial rationality is posited as the dependant variable. Based on the available literature, a positive correlation is hypothesised.

The third question examines the existence of a correlational relationship between economic reasoning and judicial rationality. The correlational variables are economic reasoning and judicial rationality. Based on the available literature, a positive correlation is hypothesised.

Based on the available literature, three hypotheses are assumed.

> **Hypothesis 1:** Judges who exhibit higher economic reasoning abilities in Section B of Test 1 will also exhibit higher legal reasoning abilities in Section A of Test 1.
>
> **Hypothesis 2**: Undergoing an economic skills training will lead to an improvement in the judicial rationality ability of judges indicated in Test 2.

Hypothesis 3: Judges who exhibit higher economic reasoning abilities in Test 1 will also exhibit higher judicial rationality abilities in Test 2.

3.2. Definitions of Variables

For the purpose of the study, working definitions of the three variables a) economic reasoning, b) judicial rationality, and c) legal reasoning were developed.

3.2.1 Economic Reasoning

Economic reasoning focuses on how individuals and institutions make choices when faced with scarcity of resources. These choices may involve evaluating the opportunity cost of the chosen decision, understanding the incentives that shape behaviour, the importance of marginal analysis, and the subjective nature of value in guiding decisions (Gordon, 2000).

The conceptualisation of economic reasoning within this study is derived from the Law and Economics model. This maintains that legal rules shape behaviour by creating incentives to which rational individuals and firms act upon to maximize their utility and profits while remaining within the constraints of the rules. This model, as illustrated by Becker's analysis of crime and Posner's study of common law, highlights the essential role of economic reasoning (Becker, 1968; Posner, 1973). Such a perspective provides judges with the tools to design legal rules in ways that would promote efficient outcomes, deter undesirable actions and enable them to effectively assess the real-world consequences of their decisions, particularly in areas such as contract law, property law, antitrust, and remedies.

Building on Posner's findings in the field of Law and Economics, the following serve as key characteristics of demonstrable economic reasoning (Posner, 1974):

1) Understanding of core economic principles: Does the judgement show an understanding of the opportunity cost, incentives and marginal trade-offs that arise as it's consequence?

2) Attention to externalities: Does the judgement result in outcomes that minimize social costs and ensure they are internalized as a cost of economic activity being undertaken?

3) Promotion of efficiency: Does the judgement consider how alternative rules or remedies could improve efficiency and align incentives?

4) Use of quantitative and empirical evidence: Does the judgement utilize data, probabilities, and measurable impacts to support itself?

The economic reasoning abilities of the participants were tested through Section B experiment instrument Test 1, containing 13 test items. Each test item consisted of a multiple-choice fact pattern with 5 answers. Only one of the given answers was correct. Participants were able to score a maximum of 13 marks.

3.2.2. Judicial Rationality

Bencze (2018) provides a compelling methodology for evaluating judicial decision-making. The quality of a judgement is dependent on (i) the correctness of the decision, and (ii) the quality of

reasoning. While reliable indicators for the correctness of a decision cannot be developed, quality of reasoning is indicated through the following benchmarks:

1. The reasoning is convincing to the parties, legal professionals, and scholars.

2. The reasoning transparently indicates the grounds of the decision.

3. The reasoning systematically differentiates between relevant and irrelevant issues.

4. The reasoning demonstrates that the court has received and contemplated the arguments raised by the parties.

5. The oral delivery of the decision is easily understandable to the parties.

These are qualitative indicators that demonstrate how well a court is able to provide reasons for its decisions. These stand in contrast to intuitive reasoning, in which judges rely on instincts, and often fallacies, to make decisions. Deliberative decision-making refers to rule-based, conscious, and rational decision-making that prioritises the application of the above-mentioned benchmarks in judicial proceedings.

The judicial rationality of the participants was tested through experiment instrument Test 2, containing 11 test items. Each test item consisted of a multiple-choice fact pattern with 5 answers. Only one of the given answers was correct. Participants were able to score a maximum of 11 points.

3.2.3. Legal Reasoning

The evaluation of legal reasoning involves two tasks:

(a) what the law currently says about a particular issue, and

(b) using this to identify how a court should rule in a case involving that issue (Dworkin, 1977).

To do this well, legal reasoning depends on two key things: interpretation and coherence (Dickson, 2016). Through interpretation, judges try to stay true to what the law already says, while also being open to clarifying, updating, or developing it where needed. Coherence ensures that interpretation doesn't become random or inconsistent. The decision must fit with the broader legal system and existing judgments or laws and, the judge's reasoning must be logically consistent and well-structured (Raz, 1994; Alexy & Peczenik, 1990).

To do this well, legal reasoning depends on two key things: interpretation and coherence (Dickson, 2016). Interpretation means that judges try to stay true to what the law already says, while also being open to clarifying, updating, or developing it where needed.

Good legal reasoning entails the following characteristics (Larmond, 2006):

1) A solid understanding of foundational legal principles. These principles are trite in legal practice and include the principles of natural law and cardinal rules of procedure and evidence. Concept questions test an understanding of these principles.
2) Respect for precedent (past decisions) which is tested by evaluating knowledge of some key precedents which also involve a discussion of natural law principles.

3) Using analogies where appropriate and following the established hierarchy of courts. Standard test items regarding analogical reasoning are used in the questionnaires. An understanding of the hierarchy of Pakistani courts, as enshrined in the Articles 189 and 201 of the Constitution, is also tested.

The legal reasoning abilities of the participants were tested through Section A of the experiment instrument Test 1, containing 13 test items. Each test item consisted of a multiple-choice fact pattern with 5 answers. Only one of the given answers was correct. Participants were able to score a maximum of 13 points.

3.3. Research Strategy

The study assesses interlinkages between economic and judicial decision-making abilities in order to provide incisive insights for improving the development of economic and judicial reasoning of District and Sessions Court Judges in Pakistan to understand the correlation between them.

The goal of the study is to develop an IRT-based model for judicial assessment for eventual implementation in judicial academies in Pakistan. This will improve the quality of training offered at judicial academies and allow trainers greater insight into the effectiveness of their training, as well as the strengths and weaknesses of the examinees.

Bearing in mind the existing research on the importance of economic reasoning competence on legal outcomes, the scope of the study will be limited to the development of economic reasoning and its correlation with judicial decision-making competence of judges.

A multiple-choice test was identified as the optimal experiment instrument for the study. The use of the test enabled meaningful comparison between participants as the items were standardised and quantifiable.

The research strategy employed in this study offers several advantages and mitigates the above-mentioned challenges. The study consists of a field experiment conducted through blind sampling at a Pakistani judicial academy, mitigating selection bias and any difficulties in obtaining a moderate sample size. This is key in ensuring the generalizability of findings to the Pakistani judge population. Experimental instruments in the form of multiple-choice tests were designed to ensure standardization of data and reliably indicate the judicial reasoning metric. The three key indicators of economic reasoning, legal reasoning, and judicial rationality were isolated and operationalized, based on available literature. Lastly, the experimental instruments were based on an Item Response Theory model. This mitigated the potential complications of a biased or flawed experimental instrument, as IRT models can identify weak test items that do not reliably indicate the abilities of the participants. The exclusion of any identified weak items contributes to the validity of the study. Additionally, the use of the 3PL model insulates the findings from bias by controlling for participant behavior.

3.4.1. Use of IRT Modelling

For the development of the experiment instrument, a 3-Parameter Logistic Model was used to estimated judges' latent ability in economic and legal reasoning. This model estimates 3 key

parameters for each test item (i.e., question) on the psychometric assessment. This allows users to calculate the probability of someone with a certain degree of ability to get that specific test item correct.

The model and the definitions of the parameters can be found as noted below:

$$P(\theta) = c + \frac{(1-c)}{1 + e^{-a(\theta - b)}}$$

1. Ability (θ)
    - It represents the level of ability being measured in the respondent.
2. Difficulty (b)
    - It is the point on the ability scale where a respondent has a 50% chance of answering correctly; harder items are positioned to the right, requiring higher ability, while easier items are to the left, requiring less ability.
3. Discrimination (a)
    - It measures how effectively an item differentiates between individuals with different ability levels; high discrimination items clearly distinguish between varying abilities, while items with negative discrimination should be revised as they incorrectly show lower ability individuals more likely to answer correctly.
4. Guessing (c)
    - This accounts for the possibility of participants selected the correct answer by chance in multiple-choice tests
    - If there are k choices, the value of this parameter cannot be greater than 1/k.

IRT has been widely recognized for its utility in developing precise, diagnostic assessments that guide effective training and capacity-building programs. It creates stronger tests that will be able to differentiate between the difficulty of each item and the aptitude of the examinee. In this way, it measures the examinee's underlying ability, and not simply their performance in the tests. This makes it an effective model for differentiating between high-ability and low-ability candidates. The theory is used in the development of all large-scale standardized tests, such as the SAT, GRE, and ACT.

A key benefit of such an IRT model is that it does not assume all items on a test as equal information and instead creates a precise methodology for identifying the items that are best at differentiating between high and low performing individuals. This feature ensures that weak or ambiguous test items are systematically eliminated during the pilot phase, resulting in a more reliable and valid assessment tool.

Furthermore, IRT indicates the abilities of examinees by measuring the changes in developmental level across various tests, accounting for any changes in the difficulty of the tests. This highlights the effectiveness of any training on the understanding of examinees with respect to every item in the

test. IRT thus played a valuable role in facilitating effective training by accounting for the development of an examinee's abilities and highlighting areas of improvement or concern.

The use of the model insulates the experiment instrument from bias by preventing flaws in the test items from skewing the judges scored in reasoning and decision-making. The model identified weaker test items, which were cleaned from the data set to prevent skew.

3.4.2. Questionnaire Development

For the purpose of the study, three psychometric assessments were developed. The final versions of the psychometric assessments have been appended (APPENDIX I). Two psychometric assessments (testing legal reasoning and economic reasoning) were compiled to form the initial test (Test 1). Additionally, a test measuring the variable 'judicial rationality' was developed, with 11 test items. The participants were asked to input unique numerical identifiers in order to compile Test 1 and Test 2 results for the participants. The research team has no way of determining the identities of participants.

A Focus Group Discussion was held, in September 2025, with members of the Lahore High Court Bar Association, in which feedback on the questionnaires was sought from senior and experienced lawyers practicing in the Lahore High Court. Fact patterns focusing on economics-centered cases were identified and recommended for incorporation into the tests.

3.4.2. Data Simulation

Following the development of the questionnaires, data simulation was conducted to ensure that the insights from the psychometric assessments of judges' legal, ethical, and economic reasoning were valid and reliable for interpretation and further analysis. This indicated whether using the IRT model for the study would be meaningful.

Three approaches were used; firstly, a 3PL model using Maximum Likelihood Estimation was applied. The results indicated that the Test Information Function (TIF) was unstable. Consequently, a 2PL version was run to check whether results were consistent when guessing was excluded as a parameter. Finally, a Bayesian 3PL model was run. The benefit of this model was that it accounted for uncertainty and provided stable estimates of the guessing parameter.

A comparison of results of items estimated across all the three models confirmed strong and weak items. This ensured the credibility of the findings of the study by ensuring consistency across any estimation method used. The results of the simulation are appended (APPENDIX II).

3.4.3. Sampling

For the purpose of reliable and generalisable results, a moderate sample size of 200 District and Sessions Court judges was sought. The sample size was informed by the requirements of the 3PL IRT model, as well as study constraints and feasibility.

A stratified random sampling method was employed to select the judges from the lower judiciary, specifically District and Sessions Courts across Sindh. Although the population sample was limited to one province, the use of random sampling allows for the generalizability of research results. The

sample ensured representation across urban and rural regions, as well as varying experience levels and educational backgrounds.

The research team faced significant access constraints in sampling. Additionally, samples formed with the knowledge and involvement of the research team would be susceptible to selection bias. Thus, the help of a judicial academy was sought. The research sample was randomly selected by the judicial academy without the involvement of the research team.

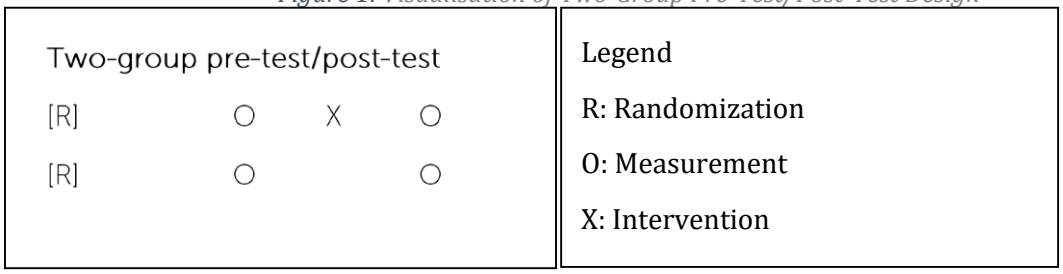
3.4.4. Judicial Testing

Judicial tests were carried out on the 15th and 16th of December 2025. Due to study and location constraints, the tests were carried out online, through the use of an online form application. The training intervention also took place through a video conferencing application. The total sample population selected was 200 judges, of which approximately 180 attended the training.

In the first phase, participants were given 45 minutes to complete Test 1. The test items were read out loud by the instructor for accessibility and convenience. Following the completion of Test 1, half of the participants (Group A) were selected at random to complete Test 2 prior to the start of the training intervention. The allocation of participants to Group A and B was concealed from the instructor and members of the research team.

In the second testing phase, participants were given a four-hour training (spread out over two days) in basic concepts regarding economic reasoning. After the training was concluded, participants from Group B were given Test 2 to complete. The following visualization depicts the test design:

Figure 1: Visualisation of Two-Group Pre-Test/Post-Test Design



Source: Authors' compilations.

The repeated measures test design raised the possibility of nuisance impact in the form of order effects. To minimize this, Test 2A and 2B were conducted on different days. The time-duration of the judicial training program was also kept short, in order to minimize the impact of fatigue effect. As judges routinely engage with the test variable topics, there is also a low presumed impact of practice effect.

FINDINGS AND DISCUSSION

In total, 167 responses were submitted for Test 1 and 126 responses were submitted for Test 2. The total experimental sample was designated as 167, of which 126 participants completed both Test 1 and 2. 81 participants were randomly assigned to Group A, of which 66 participants submitted responses. 86 participants were randomly assigned to Group B, of which 60 submitted responses.

The attrition rate for Group A was 18.52%, and the attrition rate for Group B was 30.23%. The high rate of attrition amongst participants raises concern. High attrition rates may lead to an imbalance amongst groups, affecting the validity of the study. However, high attrition rates are common in sample sizes larger than 100 (Daros et al., 2025). Furthermore, the total sample is fairly homogenous, as it is composed of District and Sessions Court Judges from a province in Pakistan. Attrition biases commonly result from differing treatments of groups, which incentivise participants in one group to exit the research at a different rate from other groups. The economic skills training was uniformly administered to both groups (after the completion of Test 2A and before the start of Test 2B). Additionally, the impact of differential attrition between Group A and Group B was tested.

To test the validity of the proportions of attrition rates among the two groups, a two-proportion Z-test was conducted. At a significance level of 0.05, it was determined that there was no significant difference between the attrition rates for Group A and Group B. At a significance level of 0.1, a significant difference between attrition rates was indicated.

4.1. Item Characteristic Curves

To improve the validity of the research results, item characteristic curves were generated for all test items in Test 1 and Test 2 for the 126 common participants. The item characteristic curves identify how well a test item discriminates between participants of higher or lower latent ability.

In Test 1, Items 3 and 5 indicated a negative value discrimination parameter. They were identified as flawed items, as they wrongly discriminated between participants of higher and lower ability. The item results were removed from the data set and the parameters and ability of participants was re-estimated.

In Test 2, Item 7 indicated a negative value discrimination parameter. This was also identified as a flawed item and was cleaned from the data set. The ability parameters of the participants were re-estimated.

A 3PL model and a 2PL model using Maximum Likelihood Estimation and a Bayesian 3PL model were used to estimate the item and ability parameters.

The use of IRT modelling thus helped improve the validity of the tests by allowing them to more effectively discriminate between high and low ability.

On the basis of these results, the ability percentiles of each participant in legal reasoning, economic reasoning, and judicial rationality were calculated. These were used to test the hypotheses.

4.2. Hypothesis 1

The first hypothesis tested was the presumed positive correlation between economic reasoning and legal reasoning. The results of Test 1 were used to test this. The association and direction of the variables was estimated through an OLS regression. Firstly, the regression was run with economic reasoning as the independent variable and legal reasoning as the dependent variable. To ensure comprehensive test results, the regression was repeated with legal reasoning as the independent variable and economic reasoning as the dependent variable. The results are given as follows:

Table 1: OLS Regression for Economic Reasoning and Legal Reasoning

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	p_theta_3PL_pre_legal	p_theta_2PL_pre_legal	p_theta_bayes_pre_legal	p_theta_3PL_pre_econ	p_theta_2PL_pre_econ	p_theta_bayes_pre_econ
p_theta_3PL_pre_econ	0.476***					
	(0.070)					
p_theta_2PL_pre_econ		0.600***				
		(0.062)				
p_theta_bayes_pre_econ			0.637***			
			(0.069)			
p_theta_3PL_pre_legal				0.569***		
				(0.084)		
p_theta_2PL_pre_legal					0.718***	
					(0.074)	
p_theta_bayes_pre_legal						0.637***
						(0.069)
Constant	25.687***	19.240***	18.152***	23.316***	15.792***	18.152***
	(4.275)	(3.775)	(4.005)	(4.883)	(4.316)	(4.005)
Observations	126	126	126	126	126	126
R-squared	0.271	0.431	0.406	0.271	0.431	0.406

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

Table 2: Hypothesis 1 Correlation Results

Variables	**(1)**	**(2)**	**(3)**
(1) p_theta_3PL_post	1.000		
(2) p_theta_3PL_pre_econ	0.450	1.000	

	(0.000)		
(3) p_theta_3PL_pre_legal	0.464	0.520	1.000
	(0.000)	(0.000)	
Variables	**(1)**	**(2)**	**(3)**
(1) p_theta_2PL_post	1.000		
(2) p_theta_2PL_pre_econ	0.448	1.000	
	(0.000)		
(3) p_theta_2PL_pre_legal	0.396	0.656	1.000
	(0.000)	(0.000)	
Variables	**(1)**	**(2)**	**(3)**
(1) p_theta_bayes_post	1.000		
(2) p_theta_bayes_pre_econ	0.462	1.000	
	(0.000)		
(3) p_theta_bayes_pre_legal	0.409	0.637	1.000
	(0.000)	(0.000)	

Source: Authors' computations.

The results of Test 1 show a significant correlation between economic reasoning and legal reasoning. For the 3PL model, the correlation coefficient was 0.52. The 2PL model resulted in a correlation coefficient of 0.656. The Bayesian 3PL model correlation coefficient was 0.637. All three models indicate a significant correlation between economic reasoning and legal reasoning. Accordingly, the first hypothesis was accepted.

4.3. Hypothesis 2

The second hypothesis presumed that an improvement in economic reasoning would cause an improvement in judicial rationality. In order to test this, all the participants who completed Test 1 were randomly allocated to Group A or B. Group A was given Test 2 prior to the training. After the test was completed, participants underwent a four and a half hour training in economic concepts. This training covered basic economic concepts, such as opportunity cost, efficiency, the time-value of money. The training served as a treatment assumed to positively impact the economic reasoning ability of participants. After the completion of the training, participants allocated to Group B were given Test 2 to complete. Group A served as the control group, and Group B served as the experimental group.

The Test 1 ability of participants was controlled to ensure the prior ability of participants did not impact the results of the causal analysis.

Table 3: Hypothesis 2 Causal Analysis

	(1)	(2)	(3)
VARIABLES	p_theta_3PL_post	p_theta_2PL_post	p_theta_bayes_post

treatment	9.018*	9.449**	8.914*
	(4.731)	(4.714)	(4.581)
p_theta_3PL_pre	0.492***		
	(0.081)		
p_theta_2PL_pre		0.496***	
		(0.080)	
p_theta_bayes_pre			0.487***
			(0.079)
Constant	21.848***	21.431***	21.392***
	(5.355)	(5.334)	(5.201)
Observations	126	126	126
R-squared	0.240	0.246	0.247

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations

The results for the 2PL model were significant at a significance level of 0.05. It was demonstrated that the treatment generated a causal effect of 9.449 ability percentile points for Group B as compared to Group A while controlling for the level of Test 1 ability percentiles. The results for the Bayesian 3PL and Maximum Likelihood Estimation 3PL models were demonstrated as insignificant.

To further understand the association between economic reasoning and judicial rationality, additional analysis was carried out. The test items in Test 2 were categorised thematically in order to determine if the type of test item influenced the results. The number of test items supported only a minimal number of thematic divisions. The items in Test 2 were categorized into one of two categories, depending on whether the items better tested numerical or conceptual skills.

Table 4: Theme Area Categorization of Test 2

Theme Area	Test 2 Question No.
Numerical skills	6, 9, 10, 11
Conceptual skills	1, 2, 3, 4, 5, 7[3], 8

Source: Authors' computations.

The ability percentiles were re-estimated according to the given theme areas.

Table 5: Ability Percentiles for Conceptual Skills

	(1)	(2)	(3)
VARIABLES	p_theta_3PL_post_conceptual	p_theta_2PL_post_conceptual	p_theta_bayes_post_conceptual

[3] As Item number 7 was considered a flawed item in the prior analysis, it was excluded from the estimation of item and ability parameters.

treatment	6.936	8.646	8.217*
	(5.376)	(5.275)	(4.704)
p_theta_3PL_pre	0.441***		
	(0.092)		
p_theta_2PL_pre		0.473***	
		(0.090)	
p_theta_bayes_pre			0.445***
			(0.081)
Constant	29.479***	27.019***	23.855***
	(6.085)	(5.968)	(5.341)
Observations	126	126	126
R-squared	0.162	0.191	0.206

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

Table 6: Ability Percentiles for Numerical Skills

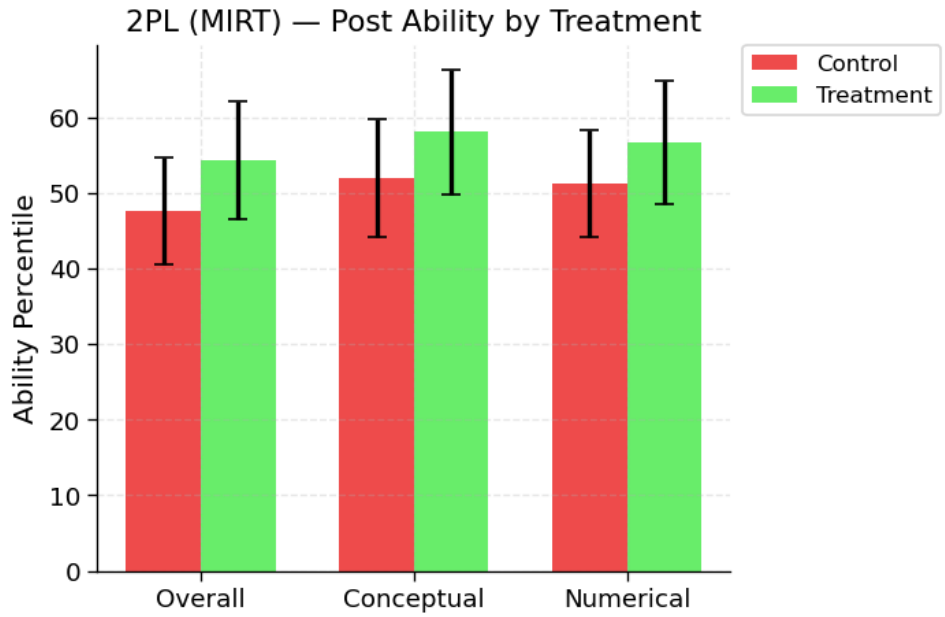
	(1)	(2)	(3)
VARIABLES	p_theta_3PL_post_numerical	p_theta_2PL_post_numerical	p_theta_bayes_post_numerical
treatment	7.771	7.934	6.852
	(5.026)	(4.934)	(4.769)
p_theta_3PL_pre	0.423***		
	(0.086)		
p_theta_2PL_pre		0.461***	
		(0.084)	
p_theta_bayes_pre			0.424***
			(0.082)
Constant	28.933***	26.932***	25.561***
	(5.690)	(5.582)	(5.414)
Observations	126	126	126
R-squared	0.172	0.203	0.184

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

The results show a nominal increase in both numerical skills and in conceptual skills of participants due to the treatment, although both values remain insignificant.

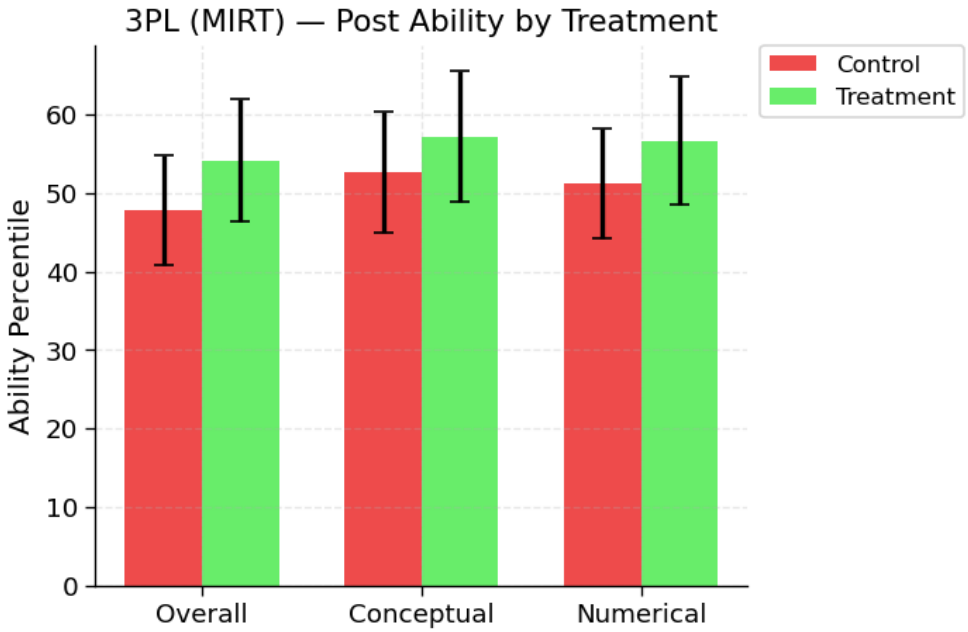
Thus, Hypothesis 2 was accepted as a causal effect of training is demonstrated on judicial rationality. However, there is insufficient evidence for determining a causal effect of training on the theme areas of conceptual and numerical skills.

Figure 2: 2PL Post Ability by Treatment



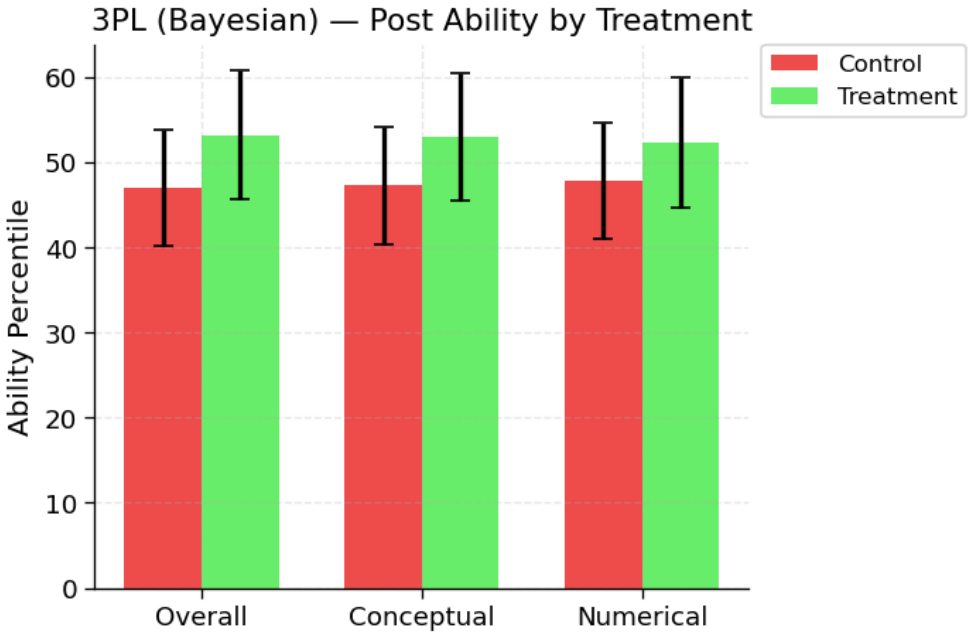
Source: Authors' computations.

Figure 3: 3PL Post Ability by Treatment



Source: Authors' computations.

Figure 4: Bayesian 3PL Post Ability by Treatment



Source: Authors' computations.

4.4. Hypothesis 3

The third hypothesis proposed a positive correlation between economic reasoning and judicial rationality.

Table 7: Association between Economic Reasoning and Judicial Rationality

Variables	**(1)**	**(2)**	**(3)**
(1) p_theta_3PL_post	1.000		
(2) p_theta_3PL_pre_econ	0.450	1.000	
	(0.000)		
(3) p_theta_3PL_pre_legal	0.464	0.520	1.000
	(0.000)	(0.000)	
Variables	**(1)**	**(2)**	**(3)**
(1) p_theta_2PL_post	1.000		
(2) p_theta_2PL_pre_econ	0.448	1.000	
	(0.000)		
(3) p_theta_2PL_pre_legal	0.396	0.656	1.000
	(0.000)	(0.000)	
Variables	**(1)**	**(2)**	**(3)**
(1) p_theta_bayes_post	1.000		

(2) p_theta_bayes_pre_econ	0.462	1.000	
	(0.000)		
(3) p_theta_bayes_pre_legal	0.409	0.637	1.000
	(0.000)	(0.000)	

Source: Authors' computations.

A significant correlation between economic reasoning and judicial rationality was demonstrated in the correlation matrix of about 0.450 for the 3PL model, 0.448 for the 2PL model, and 0.462 for the Bayesian model.

Table 8: OLS Regression of Judicial Rationality Ability on Economic Reasoning Ability

	(1)	(2)	(3)
VARIABLES	p_theta_3PL_post	p_theta_2PL_post	p_theta_bayes_post
p_theta_3PL_pre_econ	0.270***		
	(0.085)		
p_theta_3PL_pre_legal	0.324***		
	(0.093)		
p_theta_2PL_pre_econ		0.311***	
		(0.099)	
p_theta_2PL_pre_legal		0.184*	
		(0.109)	
p_theta_bayes_pre_econ			0.340***
			(0.102)
p_theta_bayes_pre_legal			0.192*
			(0.102)
Constant	20.438***	25.308***	23.389***
	(5.005)	(5.029)	(4.923)
Observations	126	126	126
R-squared	0.275	0.219	0.236

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

Furthermore, an OLS regression of the judicial rationality ability percentiles on the economic reasoning ability percentiles with the legal reasoning ability percentiles was conducted as well. The results show a significant association between economic reasoning and judicial rationality. According to the 2PL model with Maximum Likelihood Estimation, for every 1 point increase in the economic reasoning ability percentiles, participants show a 0.311 point increase in judicial rationality ability percentiles. According to the 3PL model, for every 1 point increase in the economic reasoning ability percentiles, participants show a 0.270 point increase in judicial rationality ability percentiles.

According to the Bayesian 3PL model, for every 1 point increase in the economic reasoning ability percentiles, participants show a 0.340 point increase in judicial rationality ability percentiles.

Furthermore, the association between economic reasoning and numerical skills, and economic reasoning and conceptual skills was also tested. The results show a positive and significant association between economic reasoning and numerical skills. The results also show a positive and significant association between economic reasoning and conceptual skills.

Table 9: Association between Economic Reasoning and Conceptual Skills

	(1)	(2)	(3)
VARIABLES	p_theta_3PL_post_conceptual	p_theta_2PL_post_conceptual	p_theta_bayes_post_conceptual
p_theta_3PL_pre_econ	0.226**		
	(0.096)		
p_theta_3PL_pre_legal	0.316***		
	(0.105)		
p_theta_2PL_pre_econ		0.320***	
		(0.111)	
p_theta_2PL_pre_legal		0.142	
		(0.121)	
p_theta_bayes_pre_econ			0.327***
			(0.105)
p_theta_bayes_pre_legal			0.146
			(0.105)
Constant	27.125***	31.047***	26.352***
	(5.702)	(5.606)	(5.071)
Observations	126	126	126
R-squared	0.196	0.168	0.189

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

Table 10: Association between Economic Reasoning and Numerical Skills

	(1)	(2)	(3)
VARIABLES	p_theta_3PL_post_numerical	p_theta_2PL_post_numerical	p_theta_bayes_post_numerical
p_theta_3PL_pre_econ	0.222**		
	(0.089)		
p_theta_3PL_pre_legal	0.323***		
	(0.097)		

p_theta_2PL_pre_econ		0.259**	
		(0.102)	
p_theta_2PL_pre_legal		0.235**	
		(0.112)	
p_theta_bayes_pre_econ			0.224**
			(0.105)
p_theta_bayes_pre_legal			0.267**
			(0.105)
Constant	25.985***	28.504***	25.464***
	(5.270)	(5.170)	(5.045)
Observations	126	126	126
R-squared	0.223	0.203	0.197

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

For comparison, the association between legal reasoning and judicial rationality was also tested. The different models used produced different results. The Bayesian 3PL and the 2PL model did not identify a significant association between legal reasoning and judicial rationality. The 3PL model however identified a significant association between legal and judicial rationality.

More specifically, numerical skills were something that were significantly and positively associated with legal reasoning as well as economic reasoning across all models. On the other hand, economic reasoning was identified as being significantly associated with conceptual reasoning skills across all its models while that holds true for legal reasoning only in its 3PL model. In view of this, economic reasoning holds more weight in its association with judicial rationality and its theme areas.

On the basis of the results as a whole, the hypothesis was accepted.

4.5. Experimental Results

Result 1: There is a positive correlation between a judge's economic reasoning abilities and their legal reasoning abilities. This reaffirms the importance of developing economic reasoning abilities in judges and legal practitioners.

Result 2: There is a positive correlation between a judge's economic reasoning abilities and their judicial rationality. This reaffirms the importance of utilising economic approaches in judicial decision-making.

Result 3: There is a more consistent association between economic reasoning and judicial rationality than legal reasoning and judicial rationality. This affirms the importance of economic reasoning development as a method for improving the rationality of judges.

Result 4: The use of IRT models in the development of experimental instruments allowed for greater accuracy of results by identifying flawed test items. This highlights an important use of IRT modelling in training instrument design and capacity building endeavours.

Result 5: Training judges in their economic skills causally improves their judicial rationality as per one of the estimated models with a effect size of 9.449 ability percentile points. Though this holds less significance in other estimated models as well as in theme areas (i.e. numerical skills and conceptual skills) within judicial rationality.

Result 6: Economic skills training exerts a positive impact on the judicial rationality of participants. This affirms the importance of judicial training programs in improving the abilities of judges.

CONCLUSION

The research findings identified a positive correlation between economic reasoning and legal reasoning. The research findings also identified a positive correlation between economic reasoning, legal reasoning, and judicial rationality. Of these, economic reasoning and judicial rationality were more consistently associated than legal reasoning and judicial rationality.

The research findings were able to indicate a significant causal impact of the administration of a short economic skills training on the improvement of judicial rationality in at least one of the estimated models. The findings validate the use of targeted judicial training programs in improving the abilities of judges in Pakistan.

RECOMMENDATIONS AND POLICY IMPLICATIONS

The research findings have several salient policy implications. Judicial academies should incorporate the findings into their curriculum by adding academic components dedicated to economic principles, to ensure optimal development of judicial reasoning amongst judges. The facilitation of the training intervention by a provincial judicial academy during the research process serves as proof of concept for this development. This may be expanded with the help of academia and related partners. The professional training and development of judges should be prioritized and enabled through meaningful judicial academy and academia collaborations. Law schools should also work towards the incorporation of economic theory in their legal curriculum in order to improve the deliberative and reasoning capabilities of future lawyers and judges.

Furthermore, this research was limited by its focus on the test variables. The study should be repeated with a broader scope of variables, such as ethical judgement and constitutional knowledge, in order to further explore the factors influencing judicial reasoning in Pakistan. A more controlled research environment would also increase the validity of the study and allow for better inference of causal relationships. The research should also be repeated with a modified training design, as the length and depth of training content may have impacted the results. The training instruments should also be modified for greater thematic variance and a larger number of test items.

Additionally, the study highlights many possibilities for further research into judicial decision making in Pakistan. It is recommended that research institutions prioritize further research into understanding and optimizing the way in which the judiciary functions in Pakistan. Identified areas of further research include examining the real-world social, economic, and legal impact of judicial decision-making that is not informed by economic principles, as well as the isolated impact of economic reasoning on various branches of law, such as commercial, criminal, and family law. Lastly, the study highlights the exceeding relevance of further research that examines the enduring impact of economics on other non-market disciplines and human behaviors, beyond law and economics.

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APPENDICES

Appendix I – Psychometric Test Instruments

Test 1: Legal Aptitude and Independence of Judiciary Test

Legal Reasoning

1) Consider the following statements:
   X. Whoever desires any Court to give judgment as to any legal right or liability dependent on the existence of facts which he asserts, must prove that those facts exist.
   Y. The burden of proof in a suit or proceeding lies on that person who would fail if no evidence at all were given on either side.
   Z. The burden of proof as to any particular fact lies on that person who wishes the Court to believe in its existence, unless it is provided by any law that the proof of that fact shall lie on any particular person.

Which of the following is correct?

a) X and Z
b) All of the above
c) X and Y
d) Y and Z
e) None of the above

2) Assuming that a person has been acquitted of his crime by the trial court, should the high court be hesitant in convicting him?
   a) No, the high court holds more importance than the trial court
   b) No, appeal is a fresh hearing over the matter
   c) Yes, given their acquittal, the presumption of innocence gains more value
   d) Yes, the first instance trial holds more weightage than appeal
   e) No, appeal in high court is not to be regarded as a continuation of trial

3) In light of the recent judgement of the Supreme Court in Shuhada Forum, Balochistan vs. Justice (R) Jawwad S. Khawaja, is a right of appeal still a part of due process?
   a) Yes, right to appeal has always remained a part of due process
   b) Yes, by saying that the parliament must appeal, the court gave a right which may other wise not be essential
   c) No, by saying that the parliament must provide the appeal, court undermined the importance of right of appeal
   d) No, right of appeal is important but is not an essential ingredient of due process
   e) No, constitution of Pakistan does not explicitly protect the right to due process

4) The Supreme Court of Pakistan, while hearing a petition concerning the right to assembly and freedom of expression under Articles 16 and 19 of the Constitution, passed an order permitting the Aurat March to be held in Lahore for a reasonable period of time, subject to certain narrowly tailored

restrictions regarding content to ensure public order and decency. Pursuant to this decision, the organisers began preparations for the march. However, subsequently, one of the opposing parties approached the Lahore High Court through a fresh petition, seeking additional constraints on the event. The High Court, in its ruling, held that the Aurat March could not proceed unless prior consent was obtained from the Ministry of Interior, effectively conditioning the exercise of the right on executive approval.

In these circumstances, which court's order prevails and must be complied with by the parties and the authorities?

a) The LHC because Aurat march in Lahore is not a matter that could be agitated before the Supreme Court
b) The LHC because its order is later in time
c) The SC because ministry's consent is a condition that cannot be prescribed
d) The SC because its decision binds the high court
e) Two of the above

5) Zara, a prominent environmental activist, is arrested in Lahore following her participation in a peaceful demonstration opposing a government-sponsored deforestation project in the Changa Manga reserve. The protest had drawn public attention and was covered widely by the media. She is detained under a provincial public order ordinance by law enforcement officials, who do not inform her of the specific grounds for her arrest at the time of taking her into custody. For the next three days, she is held incommunicado and denied access to legal counsel or family. After 36 hours, she is brought before a magistrate—13 hours beyond the 24-hour constitutional limit—with the authorities justifying the delay by citing travel logistics. The magistrate accepts this explanation and authorises her further remand for ten days.

   While Zara remains in custody, the provincial government issues a preventive detention order under a statute meant to address threats to public order and national security. This order contains no reasons for her detention, and instead, a confidential certificate is issued by a senior government secretary stating that disclosing such reasons would be prejudicial to public interest. Zara is not informed of any charges for a further 20 days. Eventually, a review board is constituted nearly three months after her initial arrest, but it hears the case without giving Zara an opportunity to appear or make representations in person.

   Zara files a constitutional petition challenging the legality of her detention, claiming that both the initial and subsequent phases of her custody violate her fundamental rights. Which of the following is correct?

a) a)The only violations are the initial violations of failing to provide lawyer access and informing the grounds of arrest
b) The only violations are the later failure to state reasons, inform charges, convene the review board and hear in person
c) The violations are initial violations of failing to provide lawyer access, informing the grounds of arrest and the later failure to inform charges, convening of review board and hearing in person
d) The violations are initial violations of failing to provide lawyer access, informing the grounds of arrest and the later failure to inform charges and hear in person
e) There are no violations in the above set of facts.

6) The Minister of Health and Population appears before a court. He informs that the birth rate in the country (Country X) is down this year by 12% compared to last year. The death rate in Country X has remained stable for several years. Therefore, the population of Country X is decreasing measurably. Which of the following did the minister assume while making this argument? Pick the best possible option based on the information given to you.
   a) The causes of the declining birthrate in Country X can be discovered through physician surveys.
   b) Statisticians are able to predict future changes in the size of the population of Country X.
   c) Country Y, which has a nearly identical population to Country X, is experiencing the same population shift as Country X.
   d) There was no significant migration into Country X during the time under discussion.
   e) The average age of the population in Country X has increased over the past decade.

7) Your senior judge gives you some advice. Frustration in response to insults is unreasonable, for insults are merely assertions that someone has undesirable characteristics. If such an assertion is false, the insulted judge ought to pity the ignorance prompting the insult. If it is true, the insulted judge should be thankful for such useful information.

   Which one of the following, if assumed, enables the argument's conclusion to be properly drawn?

   a) Actions prompted by ignorance do not warrant negative reactions.
   b) Frustration is an unreasonable response to useful information.
   c) Frustration is an unreasonable response to any action that should prompt pity or gratitude.
   d) Gratitude and pity are reasonable responses to some forms of hostile or insensitive behaviour.
   e) Pity is the only reasonable reaction to people with undesirable characteristics

8) Attorneys who represent violent criminals cannot both respect their clients' right to confidentiality and be sincerely concerned for the welfare of victims of future violent crimes. Reporting a client's unreported crimes violates the client's trust, but remaining silent leaves the dangerous client out of prison, free to commit more crimes.

   Which one of the following, if true, most weakens the argument?

   a) Violent criminals are no more likely to be represented by an attorney than are nonviolent criminals.
   b) Victims of future violent crimes also have a right to confidentiality should they need legal representation.
   c) The right of victims of violent crimes to compensation is as important as the right of criminals to confidentiality.
   d) An attorney who has gained a violent criminal's trust can persuade that criminal not to commit repeat offenses.
   e) Many attorneys prefer to represent nonviolent criminals rather than violent criminals.

9) In a discussion about uninterrupted access into judicial premises, it is brought to your notice as evidence that last month, a previously unused emergency stairwell in the west wing of the courthouse was recorded as having unusually high foot traffic, according to motion sensors. No such

activity has ever been recorded there before. Therefore, this spike in use must be highly unusual and possibly suspicious.

However, there is a counter argument that is offered to suggest that the above is not a fair conclusion. It is said that normally, the concerned area isn't monitored at all. The foot traffic was only noticed because the facilities team recently installed new motion sensors there as part of a pilot surveillance upgrade.

What is the form of the challenge offered?

a) Pointing out that the claim that the stairwell is "unused" is ambiguous
b) Presenting evidence that directly disproves the initial evidence
c) Offering an alternative explanation of the initial evidence
d) Undermining some of the initial evidence while agreeing with the conclusion
e) Accepting that the stairwell traffic is suspicious but suggesting that suspicious behaviour is not always cause for concern.

10) The Minister for Health has appeared before the Court to provide justification for the continued use of a specific pharmaceutical drug in the treatment of a certain disease. They submit that the continued use of the drug to treat patients with a certain disease cannot be adequately supported by the proposition that any drug that treats the disease is more effective than no treatment at all. What must also be taken into account is that this drug is very expensive and has notable side effects. Which one of the following most accurately expresses the main point of the Minister's argument?
a) The drug is more effective than no treatment at all.
b) The drug is more expensive than other forms of treatment for the disease.
c) The drug should not be used to treat the disease unless it is either effective or inexpensive.
d) The drug's possible effectiveness in treating the disease is not sufficient justification for using it.
e) The side effects of the drug are so severe that it should be immediately banned from use.

11) A public event at the judicial academy was mismanaged. The organisers explain their intent behind the planning in the following words.

The best way to create a successful public event is to visualize the attendees discussing it with others the next day. The planner should first decide what aspects of the event will lead to favorable comments from attendees during those conversations and then come up with refreshments and activities that will actually cause such post-event talk to occur. Which one of the following illustrates a principle most similar to that illustrated by the statement above?

a) When planning a municipal tourism campaign, some departments decide first where they want to attract visitors, and then plan the supporting infrastructure. But for most, budgetary constraints must also be taken into account.
b) When redesigning a public park, the landscaping team starts with laying the topsoil and then chooses the shrubbery and other plants.
c) Good legislators do not draft laws impulsively in a day without research; a law cannot be separated from the policy goals on which it is based..
d) To draft persuasive legal submissions, counsel should picture the judge accepting their conclusion, and then construct the arguments and authorities that would lead to that result.

e) Event organizers should always spend more on refreshments and decorations than on logistics, since attendees will remember the aesthetics most vividly.

12) The case of Ayesha comes before you. You find that having endured a tumultuous childhood, she has no conception of the moral difference between right and wrong, only between what is legally permitted and what is not. When she committed her offense, she did not recognize the fact that it was a morally wrong act, despite knowing that it was illegal.

From the statements above, which one of the following can be properly inferred?

a) Ayesha committed no offense that was not legally permissible.
b) Ayesha did something that was morally wrong.
c) Moral ignorance is never excusable in the eyes of the law.
d) Ayesha could now be taught the moral difference between right and wrong.
e) That law and morality are not tied together.

13) You are called to attend a panel talk. One of the panelists there, Dr Rashid, who is an expert in legal technology makes the following claim:

"Online legal databases now provide citizens with access to more statutes, case law, and legal commentary than ever before. Therefore, most individuals can acquire the knowledge they need to resolve legal matters on their own, without hiring lawyers."

Ms. Iqbal who is a professor of jurisprudence sitting on the panel rushes to rebut in the following words:

"Historically, as the volume and complexity of legal knowledge have increased, so has the need for professional legal interpretation. Consequently, greater access to legal texts online will, in fact, increase people's dependence on legal counsel."

The exchange most strongly supports the claim that Dr. Rashid and Ms. Iqbal disagree with each other about whether

a) Online legal databases will significantly expand access to legal information across society
b) Greater online access to legal materials will increase the likelihood that individuals will seek legal representation
c) Online platforms have made legal texts more accessible to the general public
d) Legal professionals will rely more heavily on digital tools in the future
e) Historically, there has been an under reliance on online legal tools

Economic Reasoning

1) What does the concept of opportunity cost mean in economics?
   a) The cost of goods sold.
   b) The amount paid for resources.
   c) The value of the next best alternative forgone.
   d) The financial expense recorded in a transaction.
   e) The total revenue earned from selling a product.

2) Which of the following best describes a monopoly and its likely effect on the market?
   a) A market with many buyers and sellers, leading to competitive prices.
   b) A market with several large firms and low barriers to entry, ensuring efficiency.
   c) A market with one dominant seller that restricts entry, often resulting in reduced consumer choice and higher prices.
   d) A market with perfect information and no firm able to influence prices.
   e) A market where firms collude to set prices but still allow easy entry for new competitors.

3) What is the purpose of taxes in correcting market outcomes?
   a) To correct negative externalities.
   b) To reduce employment.
   c) To increase subsidies.
   d) To increase private profits.
   e) To eliminate consumer demand for all goods.

4) Which of the following outcomes is most likely when the government sets a maximum price (price ceiling) below the market equilibrium, for example, on fuel or rent?

   a) Supply increases as producers try to meet rising demand.
   b) Demand falls because consumers expect lower quality.
   c) A shortage emerges because quantity demanded exceeds quantity supplied.
   d) The market reaches a new, stable equilibrium without intervention.
   e) A surplus develops as producers flood the market with excess supply.

5) Which of the following reflects the correct understanding of the time value of money?

   a) Money today is worth more than the same amount in the future.
   b) Money keeps its value unless inflation is high.
   c) Future money is more valuable due to rising prices.
   d) Holding cash increases its value over time.
   e) The value of money remains constant over time, regardless of interest or inflation.

6) Which of the following best describes the Coase Theorem?

   a) Externalities can only be corrected through government taxes or subsidies.
   b) In the presence of externalities, markets always fail to reach efficient outcomes.
   c) If property rights are well-defined and transaction costs are low, private bargaining can lead to an efficient outcome.
   d) The party who suffers harm is always entitled to compensation from the party who caused it.

e) Efficiency is guaranteed even when property rights are unclear and transaction costs are high.

7) A supplier files a claim for damages after a contract is terminated. They demand reimbursement for all the money they invested in equipment and setup after signing the contract, even though the contract doesn't guarantee compensation for such costs. The supplier argues, "We've already spent so much, we deserve to recover it."

   Which reasoning best reflects the court's likely response?

   a) The supplier is protected under implied terms of effort-based compensation.
   b) The supplier's reasoning reflects the sunk cost fallacy, and the court is likely to deny reimbursement.
   c) The court must award damages to avoid unjust enrichment.
   d) Investment alone is a sufficient basis for compensation.

Courts generally compensate all business risks undertaken by firms, regardless of contract terms.

8) A court is reviewing a compensation dispute involving a small business owner who sold their store to open a consultancy firm. The owner's lawyer claims the income from the new firm should be judged in light of what was given up.

   What economic concept helps assess this tradeoff?

   a) Sunk cost.
   b) Marginal cost.
   c) Opportunity cost.
   d) Average cost.
   e) Comparative advantage.

9) A judge must decide whether a subsidy for electric cars is justified. The government claims it reduces air pollution and benefits everyone, not just the buyer. Which economic idea supports this reasoning?

   a) Price discrimination.
   b) Free markets are always efficient.
   c) Positive externalities.
   d) Creative destruction.

Tragedy of the commons.

10) From an economics standpoint, which of the following is the most significant concern associated with cartel formation?
   a) Cartels leads to higher prices and restricted output, resulting in allocative inefficiency and deadweight loss.
   b) Cartels eliminate price competition, making it harder for new firms to enter the market.
   c) Coordinated behavior among firms reduces incentives to invest in cost-saving innovations.
   d) Cartel members may still cheat on agreements, leading to unstable pricing and market unpredictability.
   e) Cartels guarantee stable markets and long-term benefits for consumers.

11) Which of the following would most likely cause an increase in market supply?
    a) Higher wages demanded by workers.
    b) A decrease in the cost of raw materials.
    c) A new tax on producers.
    d) A drop in consumer interest.

Stricter government regulations that increase compliance costs.

12) Which scenario best illustrates the law of demand?
    a) A fall in smartphone prices leads to increased purchases.
    b) A rise in rents leads to increased demand for apartments.
    c) A drop in textbook prices leads to fewer students buying them.
    d) An increase in food prices leads to people buying more snacks.
    e) A decrease in movie ticket prices results in no change in attendance.

13) In setting a fine for illegal dumping, a judge considers not just the immediate damage but the long-term effect on public health. This reflects:
    a) Market equilibrium.
    b) Moral hazard.
    c) Free-riding behavior.
    d) Externalities.
    e) Comparative advantage.

Test 2: Judicial Rationality Test

1) A woman, Ayesha purchased a mango juice at a local café, the juice had been bottled and sealed by a local manufacturer. After drinking half the bottle, she discovered a dead fly floating inside of it. Afterwards she was hospitalized with a severe illness and incurred significant medical expenses due to it. She decided to sue the manufacturer for the expenses incurred due to the incident, despite not having purchased the juice directly from them.

   In this scenario, what decision should be made from the following:

   a) Only the café is responsible as Ayesha had purchased the juice from them, not the manufacturer.
   b) Ayesha cannot sue as she should have inspected or investigated the juice box for harmful contents before drinking from it.
   c) As quality control measures increase production costs, increasing the liability of the manufacturer would hurt economic efficiency.
   d) The manufacturer owes a duty of care to Ayesha even without a formal contract as customers are foreseeably affected by defective products.
   e) The case is about contract law, and without a contract there can be no liability.

*Reason: As per the **Donoghue v. Stevenson (1932)** case, it was established that the manufacturer owed a duty of care to consumers of its products. Investment in quality control by manufacturers ultimately benefits consumers and society thus promoting economic efficiency by reducing the risk of harm and the ensuing costs arising from it.*

2) A group of children living in a village near a chemical plant (it had strong profit margins for the preceding 5 years) had started to fall sick. Upon inspection by a well-reputed medical practitioner, it was diagnosed that the toxic fumes released from the chemical plant had been affecting their health. This led to a lawsuit against the plant on behalf of the children demanding compensation for the medical expenses they suffered because of the sickness.

   Based on the legal principles and economic efficiency, which judgement is the best suited resolution for this case?

   (a) Rule in favor of the chemical plant, industrial activity creates jobs in a local community and thus pollution is an acceptable cost of it.
   (b) Order the shut-down of the chemical plant as its activities are comprising the living conditions of the village thus incurring significant social costs.
   (c) Hold the chemical plant liable for pollution, requiring it to compensate the children and their parents while also ordering them to invest in pollution control to continue their functions.
   (d) Hold the government accountable to subsidize medical treatment for the children.
   (e) Dismiss the case on the basis that the community is free to relocate and by not exercising that right, they have chosen to live near the chemical plant given the risk of pollution.

*Reason: As per the **Guerrero v. H.B. Fuller Company (2008)** case, the court-imposed penalties and ordered for the children to be compensated for their health issues arising from the fact that they had inhaled toxic fumes from H.B. Fuller's chemical plant. The underlying economic principle at play here is of externalities and of the Coase theorem as well, as property rights over environment were not defined accordingly the Chemical plant had not internalized the costs they were incurring on society as a whole and thus based on their own private costs and benefits were continuing their activity which seemed profitable to them. This decision forces them to make economic decisions based on social costs, thus increasing welfare and by defining property rights ensure that in the future they negotiate directly with local communities with regard to environmental pollution.*

3) Ali owned a cargo boat docked at a high-traffic port managed by the Karachi Port Trust. One morning the boat broke free from its constraints (he had left no watchmen to manage the boat in his absence) and collided with a nearby fuel tanker, causing not just damage to it but also creating a fire hazard. The case was brought to the attention of the court, which had to decide whether Ali was liable to a penalty for not securing his boat properly or was this an accident for which no one could be held liable?

   (a) Accidents at busy ports are frequent occurrences and therefore a risk accepted by all parties when docking there thus no one is liable.
   (b) Karachi Port Trust is liable since they manage the port.
   (c) The Owners of the Oil Tanker are liable for all the damage occurred as they had not made their ship sufficiently durable against collisions.
   (d) Both Ali and the Karachi Port Trust share responsibility as it was their joint responsibility to ensure that constraints were in place for Ali's boat.
   (e) Ali is liable as the cost of having the necessary precautions (i.e. having a watchmen always be present on the boat) that he could have made are lower than the expected harm from the accident.

*Reason: As per the **United States v. Carroll Towing Co. (1947)** case, the court devised a formula on the basis of economic reasoning that essentially involved looking at a cost-benefit analysis of Ali having made the necessary precautions, essentially using what it called the "Hand Formula", if the burden of taking precautions is less than the probability of harm multiplied by the potential loss then the precautions should have been taken by relevant party and if they weren't then it would be held liable for an accident. Thus, based on this principle, option (e) stood as the correct judgement to this question.*

4) PakTech is the largest technology company in Pakistan, dominating the market for computer operating systems in Pakistan with it's PakOS which is used on all operating systems for devices made in Pakistan. Recently PakTech began bundling it's PakOS with a free browser called PakBrowse that came pre-installed with it, however in the process of doing so it made it difficult for other browser applications to be installed on PakOS relative to before this move thus setting its own free browser as the default option for most consumers. Several of these competitors filled complaints with the Competition Commission of Pakistan, arguing that PakTech was abusing it's monopoly power to restrict competition in the browser market by preventing consumers from having alternative or any other meaningful choice except for PakBrowse.

   For this case, what is the valid decision that should be made by the Competition Commission of Pakistan?

   (a) PakTech is not liable since consumers were gaining access to a free and convenient browser.
   (b) PakTech is not liable since competitors are responsible for making their browsers seem a more attractive option to consumers.
   (c) PakTech is liable and required to unbundle PakBrowse from PakOS while also making it easier for other browsers to be installed.
   (d) PakTech is liable and should be banned from operations in Pakistan for its actions of creating a monopoly around itself.
   (e) PakTech is liable and should face no other consequences except a fine.

*Reason: As established in **United States v. Microsoft Corp. (2001)**, such bundling qualifies as monopolistic behavior. Thus, for the sake of economic efficiency, we need to understand that such actions, despite their short-term benefit of providing a free service, in the long term create significant deadweight loss as due to a lack of competition in a market we see little innovation and thus consumer welfare suffer as their will be no pressure on PakTech to improve its browser quality. Thus, undoing this bundling protects consumer welfare.*

5) Mariam was waiting for her train while sitting by a pedestal fan, at this time an employee of Pakistan Railways was helping another passenger with their luggage, one such item from the luggage held by the passenger were a set of fireworks. The passenger accidentally dropped this set of fireworks while handing them to the employee, thus causing them to explode and hit the fan right next to Mariam causing it to fall and injure her. As a result of this incident, Mariam sued Pakistan Railways for the harm she suffered and demanded compensation from them.

   Which of the following is the appropriate judgement for this case:

   (a) Pakistan Railways should compensate her, since an injury caused by its employees should make the company responsible.

(b) Pakistan Railways is not liable as the injury to Mariam was not a foreseeable consequence of the employee's action.
(c) The passenger carrying the fireworks is responsible, since fireworks are inherently explosive and they should have foreseen the risks of bringing such a package.
(d) Both Pakistan Railways and the passenger are jointly responsible, as both contributed to the accident.
(e) Pakistan Railways should compensate her, as it is strictly liable for all accidents occurring on its premises.

Reason: To better understand why (b) is the answer we need to look at ***Palsgraf v. Long Island Railroad Co. (1928)*** *which essentially established that firms should take measures to deal with foreseeable incidents but not so for unforeseeable ones such as the one in the case of Mariam, while unfortunate, it was not a chain of events foreseeable for the passenger and Pakistan Railways, thus any other option would have induced significant liability for them. For economic efficiency, while encouraging precautions is necessary, however this needs to be balanced against the excessive costs arising from making precautions for unpredictable events which end up hurting economic productivity.*

6) In 2021, a private buyer entered into a written agreement with Capital Nest Developers (Pvt.) Ltd. for the purchase of a 1-kanal residential plot in a gated housing scheme near Islamabad. The buyer paid Rs. 1 crore in advance under a contract that promised delivery of the plot within 12 months. Three years have now passed, and the buyer has not received possession of the plot. In court, the developer concedes that the plot cannot be delivered due to unresolved land title complications and overbooking. The developer offers to refund the original Rs. 1 crore and argues that the delay was caused by factors beyond their control.

   The buyer, however, claims that he has suffered significant financial loss due to the prolonged delay. He argues that his funds remained locked for three years, during which time he could have earned substantial returns through other investments. He emphasizes that even if specific performance is no longer possible, the refund alone is insufficient because the value of money has declined. He demands compensation for the delay.

   The developer maintains that since the deal is being cancelled and the principal amount is being returned in full, there is no legal basis for any additional amount. They add that the buyer is an experienced investor who understood the risks associated with property booking in early-stage schemes, and that no formal legal claim was raised for nearly two years after the agreement.

   As the presiding judge, which of the following remedies would best reflect a fair and economically sound outcome?

   (a) Return of Rs. 1 crore only.
   (b) Return of Rs. 1 crore plus interest based on the policy rate (e.g., 15%).
   (c) Restitution only (return of any unjust enrichment to the developer).
   (d) Return of Rs. 1 crore plus damages for lost investment opportunities.
   (e) Developer must provide a 1-kanal plot as originally promised, regardless of feasibility.

Reason: Option (b) ensures that not only does the buyer's principal investment amount is returned but also compensates him for the opportunity cost by awarding interest based on the policy rate thus accounting for inflation and time value of money. This decision also ensures that developers internalize the cost of delays.

7) In response to a significant rise in healthcare costs, the federal government issued a notification proposing a fixed retail price for commonly used painkillers, including paracetamol and ibuprofen. The stated aim is to ensure affordability and protect low-income households. However, pharmaceutical manufacturers challenge the move in court, arguing that fixed pricing may reduce supply, compromise drug quality, and discourage production if rising input costs are not considered.

   Consumer rights groups support the government's decision, emphasizing the need for price stability. The government has not provided a clear formula for how the fixed prices were calculated, nor has it introduced a process for firms to request adjustments in case of cost fluctuations.

   As the presiding judge applying economic reasoning, how should the price be determined?

   (a) The price should remain fixed at current levels to protect consumers.

   (b) The price should not be regulated at all and left to market forces.

   (c) The price should be benchmarked against the price of similar painkillers, considering cost and reasonable profit.

   (d) A price ceiling should be imposed, but firms may apply for exceptions based on justified cost increases.

   (e) The price should be set permanently below production cost to maximize affordability.

Reason: Option (c) provides a reasonable formula for determining prices without undermining supply (as price controls in (a), (d) and (e) would have done) while at the same time ensuring affordability (something option (b) fails to accomplish).

8) In a developing residential area on the outskirts of Lahore, a cement manufacturing plant has been operating for several years. Residents of a newly constructed nearby housing colony have filed a lawsuit, claiming that air pollution and dust from the plant have caused increased respiratory illnesses and property damage. Medical reports and environmental studies confirm elevated pollution levels near the plant.

   The cement company argues that it holds a valid operating license and the housing society was developed after the factory was already in operation. Shutting down or altering production would result in significant economic loss and job cuts.

   The residents are seeking damages and an injunction limiting plant operations during certain hours.

   As the judge, what is the most efficient and fair remedy?

(a) Grant the injunction and order the factory to cease operations during peak residential hours.

(b) Dismiss the case, as the residents chose to move near an existing factory.

(c) Award compensation to residents but allow the plant to continue operating with no restrictions.

(d) Require the factory to install dust and air filters, and allow continued operation while reducing harm.

(e) Allow the factory to operate without restrictions as long as it pays higher corporate taxes to the government.

Reason: Option (d) stands as the best option as it not only internalizes the cost of the harm to any third-party (option (b) ignores the externality altogether), ensuring that no harm occurs in the future (something that option (e) and (c) fail to do) while at the same time preserving productive activity (option (a) ends up imposing economic costs in terms of job losses).

9) A mother files a claim in family court for 18 months of unpaid child maintenance. Her ex-husband, despite a prior court order, did not make any monthly payments. For the first 12 months, the child's monthly living, educational, and medical expenses were Rs. 38,000. For the last 6 months, these costs increased to Rs. 55,000/month due to a school change and increased healthcare needs.

   The mother now seeks a lump sum award for the unpaid amount, along with a 15% annual simple interest adjustment to account for the lost value of money caused by the delay. She argues that the financial burden caused by delay justifies the inclusion of interest.

   The father, a software engineer earning Rs. 300,000/month, claims that while he missed regular payments, he covered Rs. 50,000 worth of expenses for the child's school uniform and exam registration fees during this period. He argues this should be deducted from the owed amount, and that interest is unfair given that the child wasn't entirely unsupported.

   If interest is awarded, assume an average delay of 12 months for the first 12 months of payments, and 3 months for the last 6 months.

   Based on the information provided, should interest be awarded, and what is the most appropriate lump sum compensation?

   (a) Yes; award Rs. 866,775

   (b) Yes; award Rs. 816,775

   (c) Yes; award Rs. 866,115

   (d) No; award Rs. 786,000

   (e) No; award Rs. 736,000

Reason: The calculation for reaching option (b) is as follows:

*38,000 * 12 = 456,000*

*456,000 * 1.15 = 524400*

*55,000 * 6 = 330,000*

*330,000 * (1 + (0.15/4)) = 342375*

342375 + 524400 = 866775

866775 – 50000 = 816775

10) Over the course of one week, three major oil distribution firms in Sindh independently increased diesel and petrol prices by exactly Rs. 11.50/litre. The adjustments occurred within a 72-hour period. Collectively, the three firms control more than 80% of the provincial fuel market. Each claims the pricing change was based on rising operational costs, especially due to recent rupee depreciation and fuel transport disruptions. The Ministry of Petroleum had made no recent changes to tax rates or regulatory price floors.

    Smaller competitors, who make up less than 20% of the market, maintained existing prices. A public interest petition is filed, alleging that the three firms engaged in collusive pricing in violation of competition law. The petitioners argue that identical price increases, implemented nearly simultaneously, suggest market manipulation and reduced consumer welfare. No meetings, correspondence, or agreements between the firms are presented in court. The oil companies argue that in a highly monitored sector, similar cost inputs and pricing strategies naturally lead to similar outcomes, and that this is not evidence of anti-competitive behavior.

    As the judge hearing this case, and applying economic reasoning, how should the conduct be classified, and what is the most appropriate action?

    (a) Dismiss the case, this is natural price alignment based on shared cost drivers.

    (b) Issue a warning but take no further action, behavior is suspicious but unproven.

    (c) Initiate formal investigation for potential collusion, coordination is likely despite lack of direct evidence.

    (d) Rule that market remains competitive due to presence of smaller firms, no violation occurred.

    (e) Immediately fine the firms and order a price rollback, treating identical price changes as conclusive proof of collusion.

Reason: Option (c) stands as the most appropriate action, primarily as it is clear the market share is concentrated in the hands of just a few firms thus giving them significant leverage to manipulate prices (option (d) is invalid as presence of smaller firms is not sufficient as their market share is important as well). By going with option (c) we ensure protection of consumer welfare (something that is not occurring in option (a) or option (b) which impose no financial penalties.) while at the same time ensuring that no action is taken without sufficient proof (option (e) immediately assumes guilt without any proper formal investigation).

11) A shopping mall uses powerful floodlights at night to illuminate its premises, but these lights shine directly into the windows of nearby residential apartments, causing significant discomfort. The estimated annual loss in utility to the residents due to this light pollution is Rs. 200,000. The mall has the option to install downward-facing light shields that would eliminate the issue at a cost of Rs. 50,000 per year. Alternatively, the residents could install blackout curtains in their homes at a

total cost of Rs. 120,000 per year. Assume there are zero transaction costs and that both parties are capable of bargaining. Which of the following outcomes would lead to the most efficient result?

(a) The residents should install blackout curtains at a cost of Rs. 120,000/year.

(b) The mall should be held liable and required to install the light shields costing Rs. 50,000/year.

(c) The mall should be free to keep the lights on without shielding, and residents must bear the discomfort.

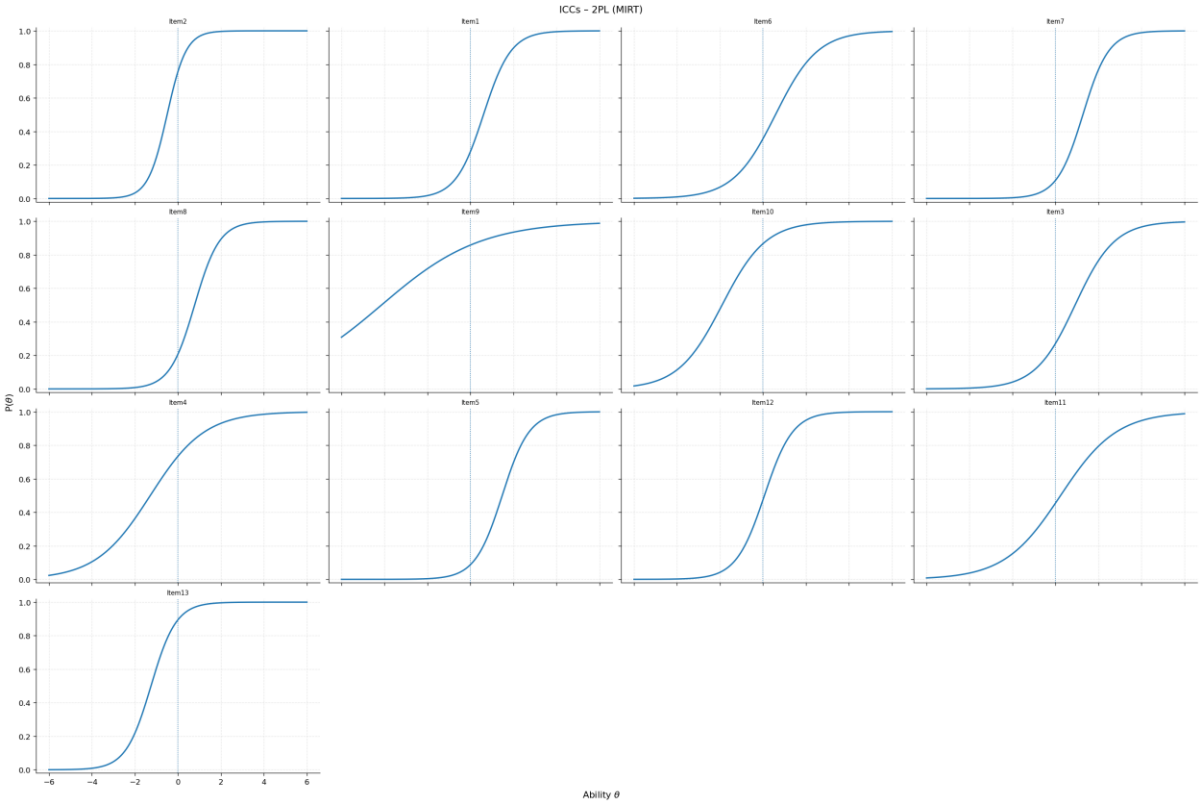
(d) The mall should turn off the floodlights completely to avoid all externalities.

(e) The residents should be compensated Rs. 200,000 annually by the mall, while no light shields or curtains are installed.

Reason: The correct answer is option (b) as it tackles internalizes the social cost of the externality in the most cost-efficient way as compared to option (a) and (e) and puts the burden on the shopping mall to cover it instead of any other third-party (like in option (c), which ignores externality altogether.) while not putting any restrictions on the shopping mall's operational needs (as option (d) suggests).

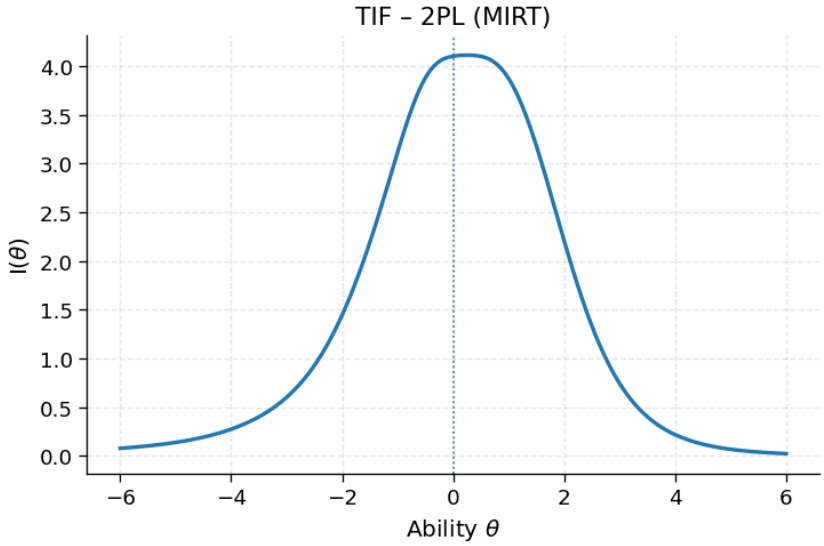
Appendix II- Simulated Data

Figure 5: Simulated Data ICCS for 2PL



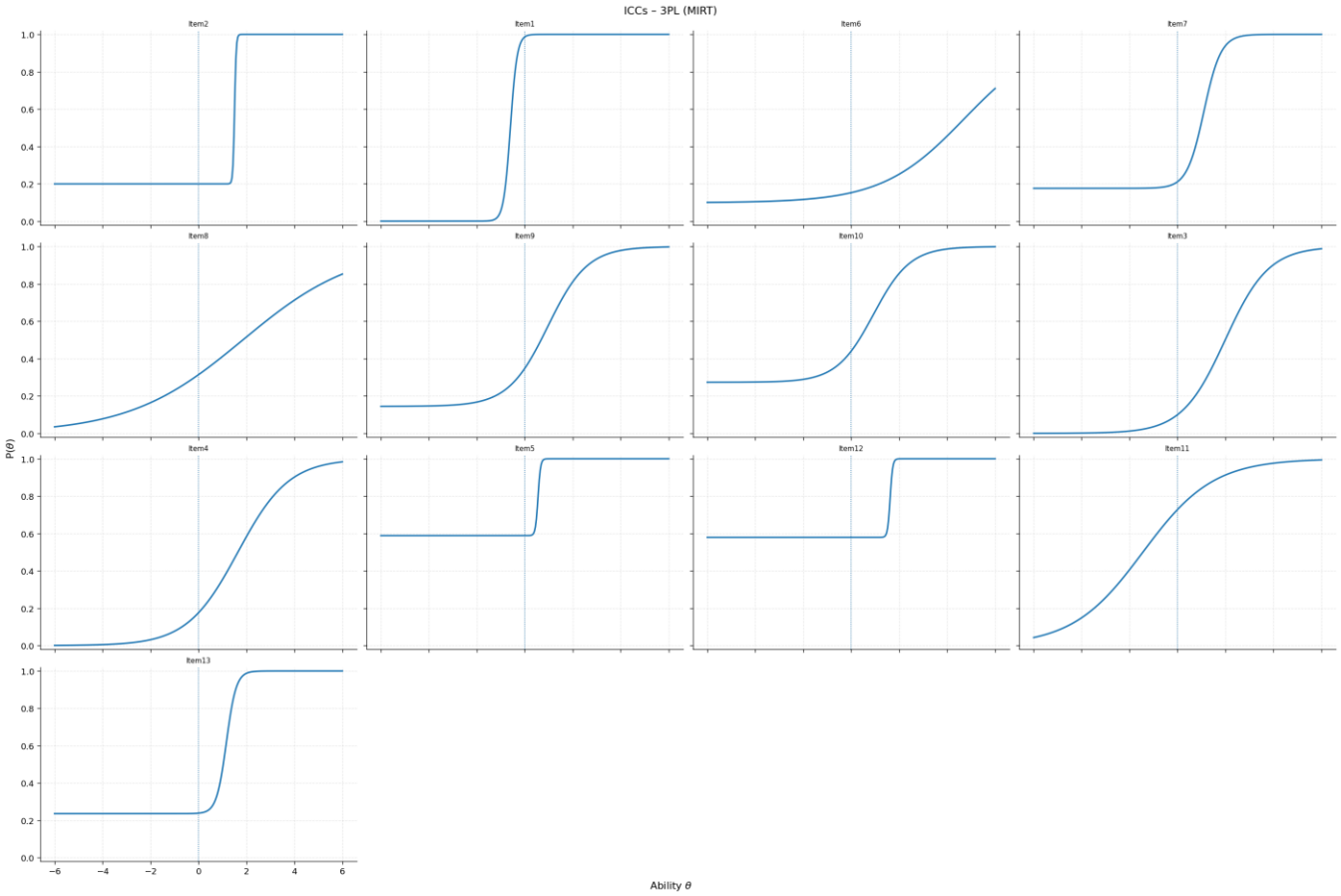
Source: Authors' computations.

Figure 6: Simulated Data TIF for 2PL



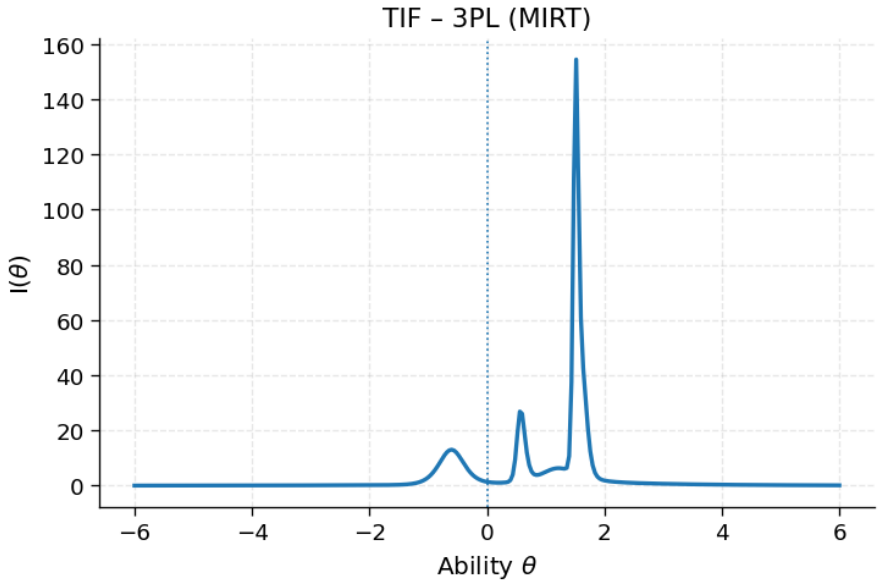
Source: Authors' computations.

Figure 7: Simulated Data ICCs for 3PL



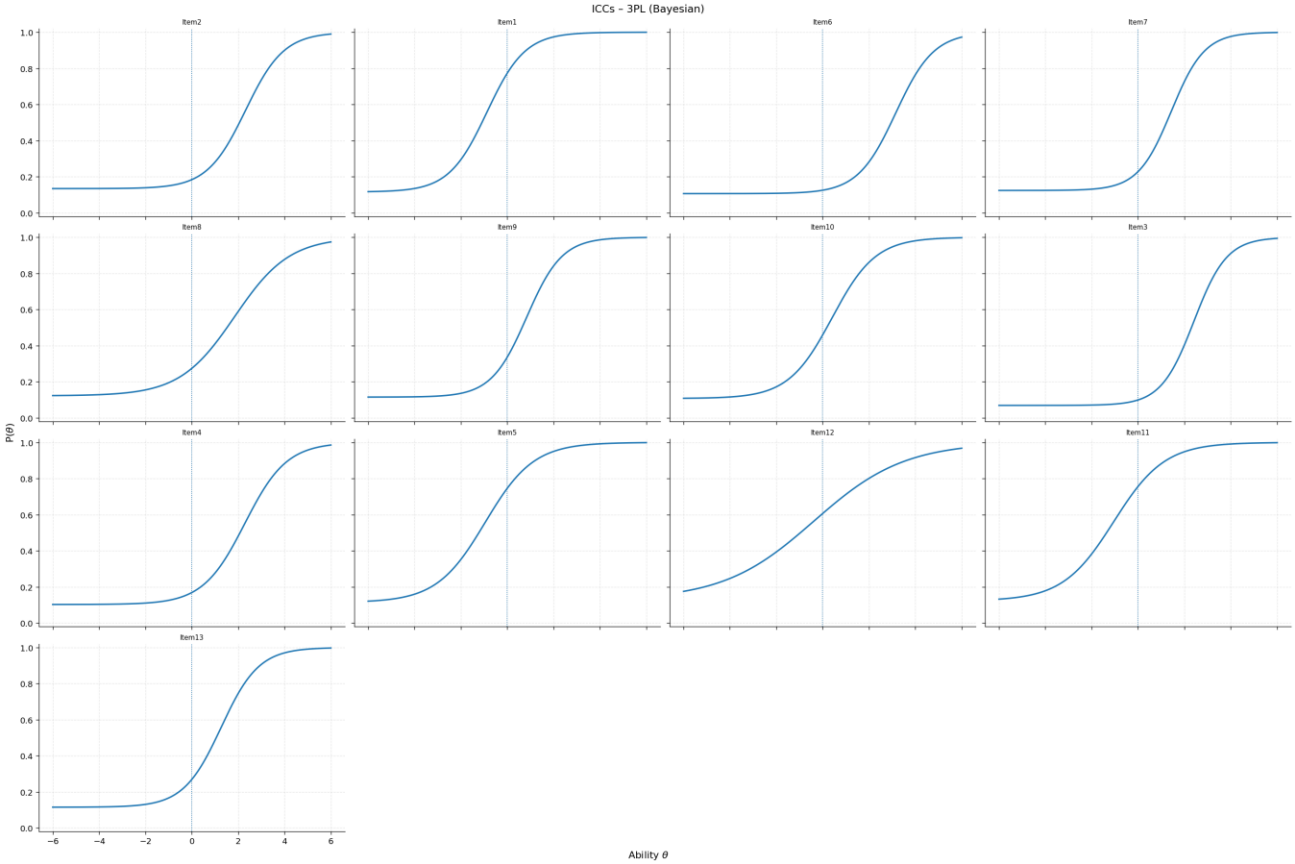
Source: Authors' computations.

Figure 8: Simulated Data TIF for 3PL



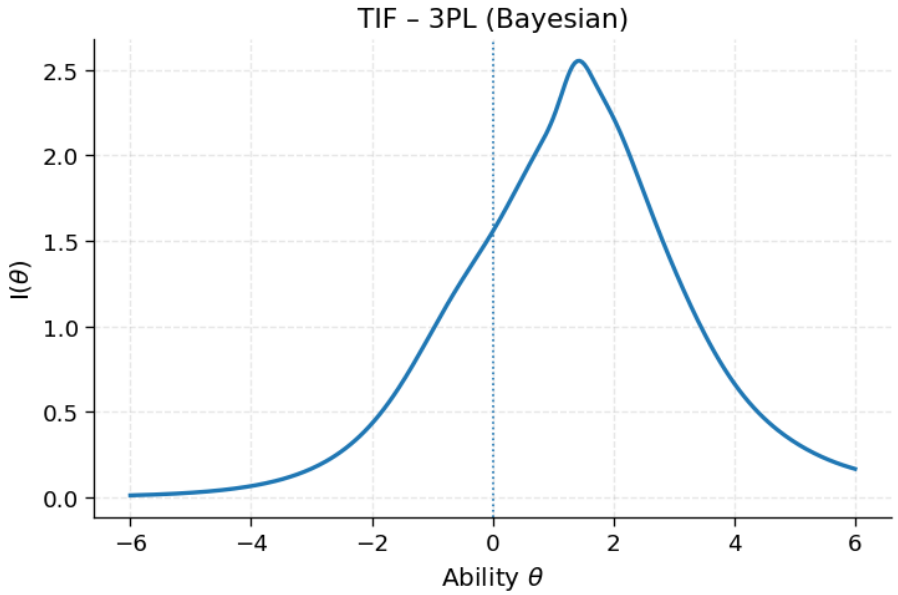
Source: Authors' computations.

Figure 9: Simulated Data ICCs for Bayesian 3PL



Source: Authors' computations.

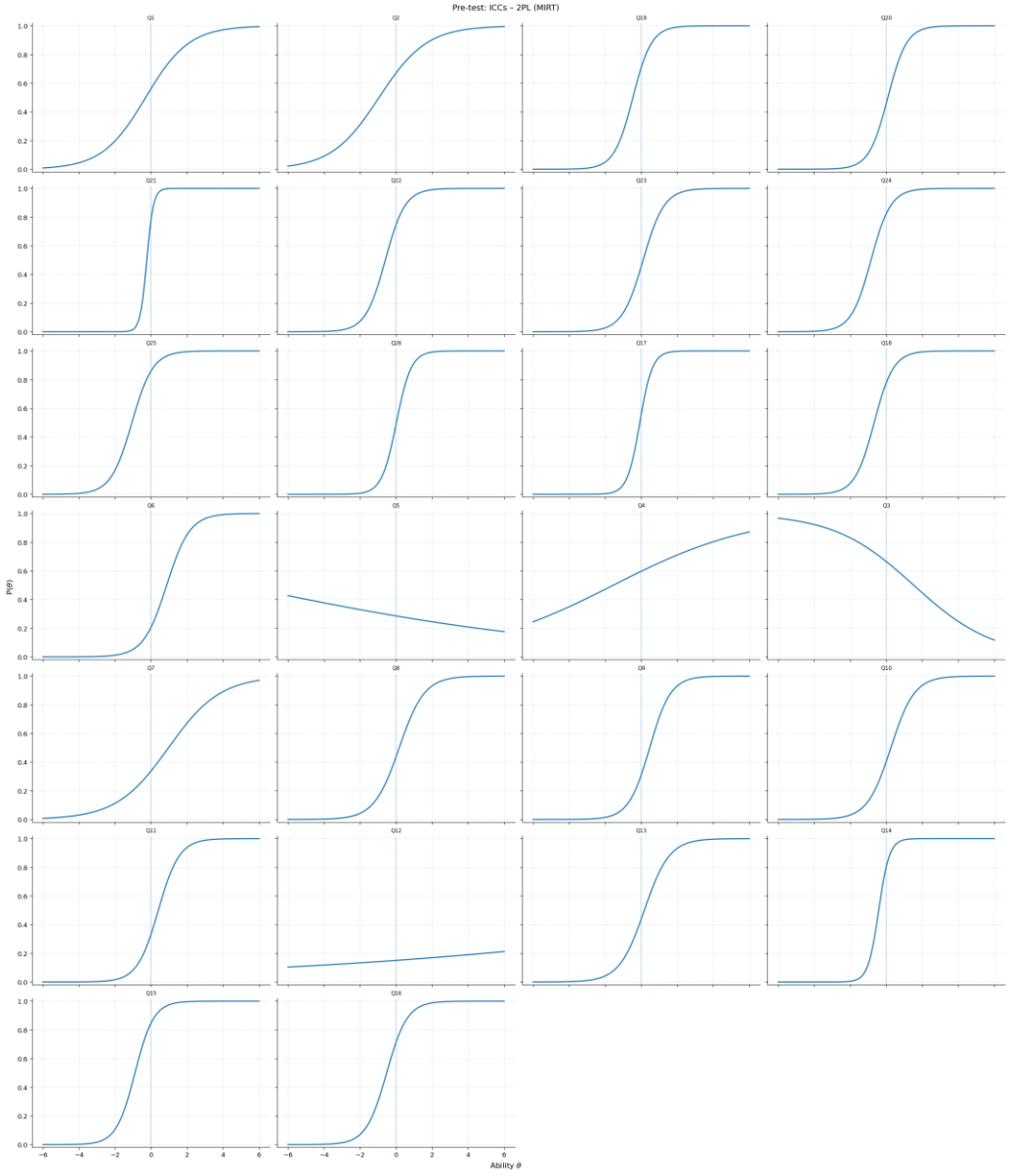
Figure 10: Simulated Data TIF for Bayesian 3PL



Source: Authors' computations.

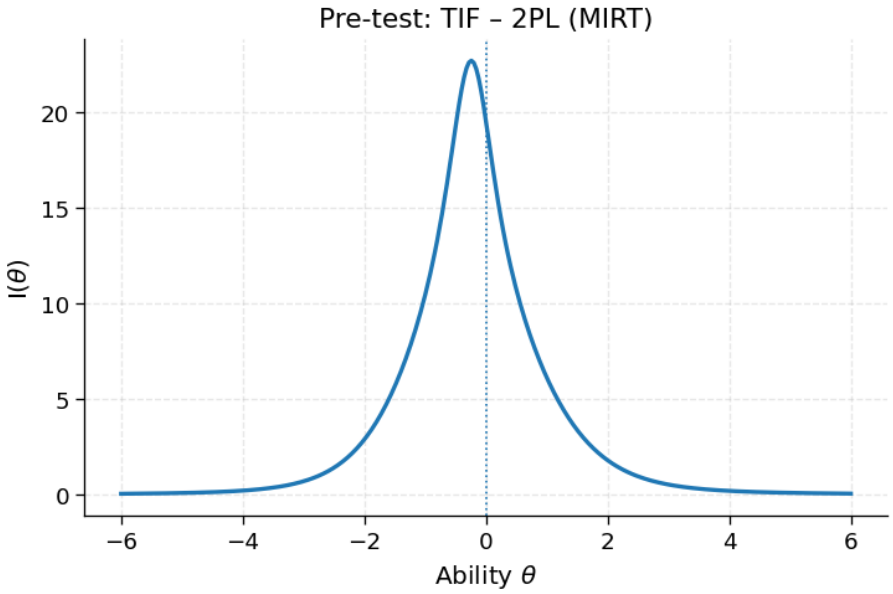
Appendix III – Item Characteristic Curves and Total Information Function

Figure 11: Test 1ICCs for 2PL



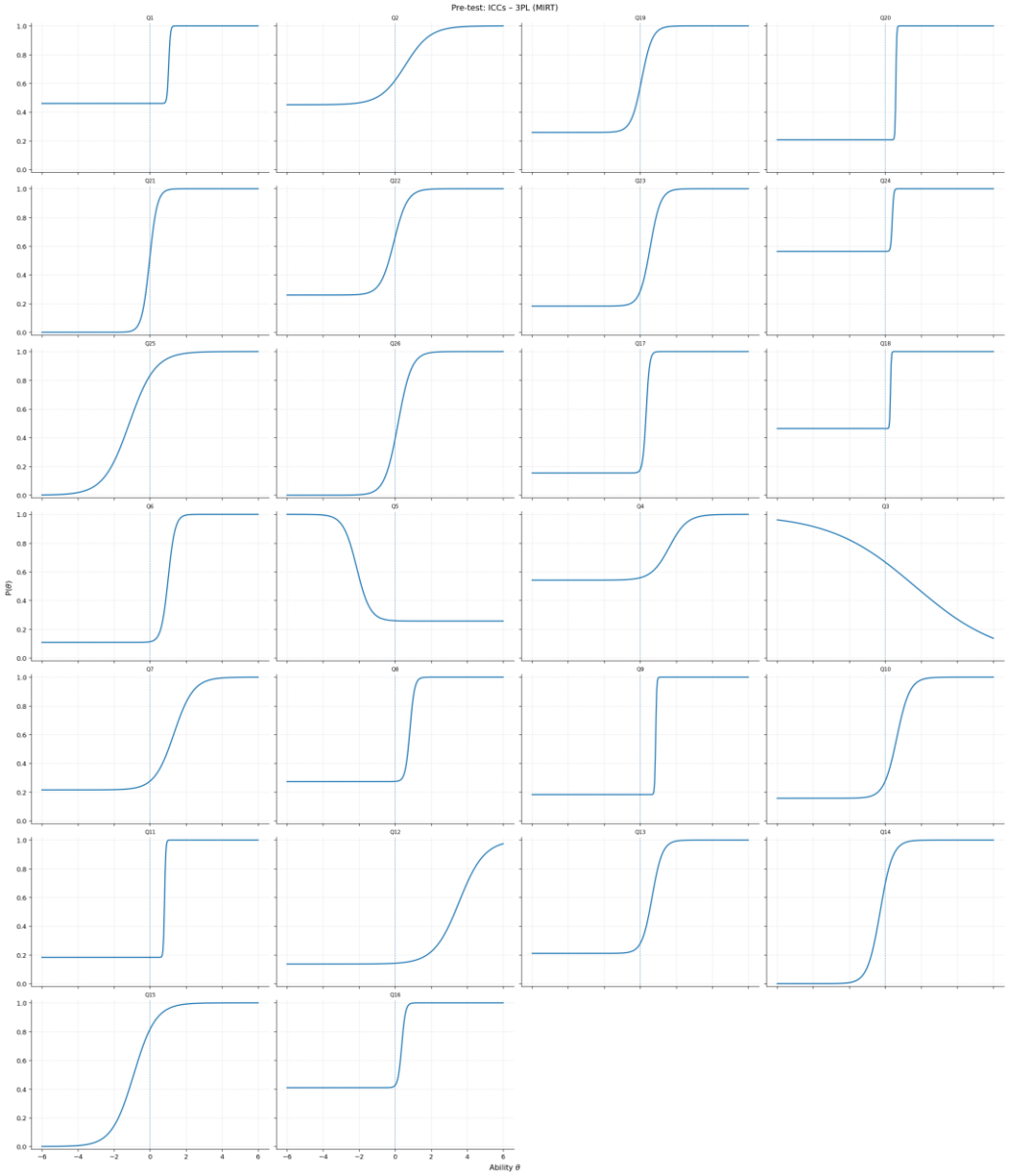
Source: Authors' computations.

Figure 12: Test 1 TIF for 2PL



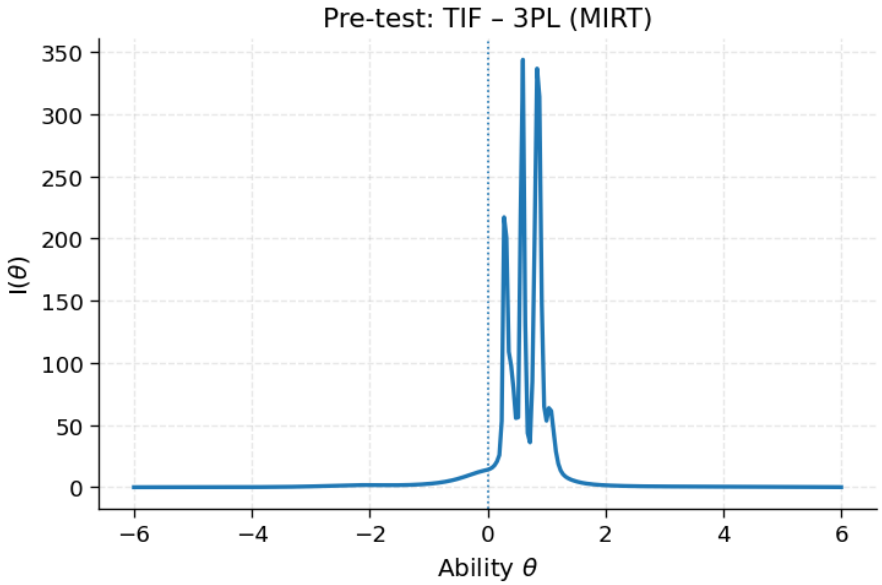
Source: Authors' computations.

Figure 13: Test 1 ICCs for 3PL



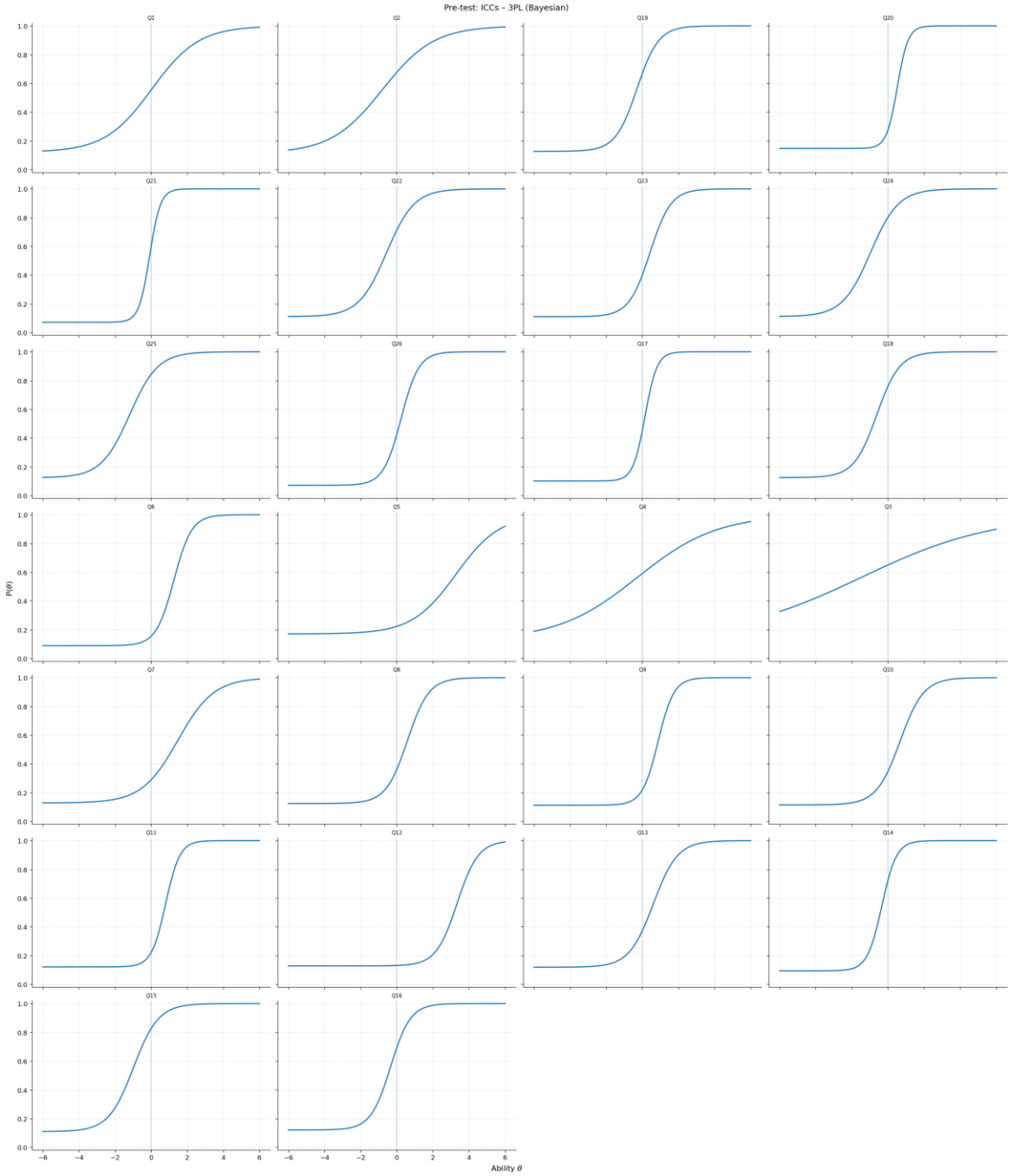
Source: Authors' computations.

Figure 14: Test 1 TIF for 3PL



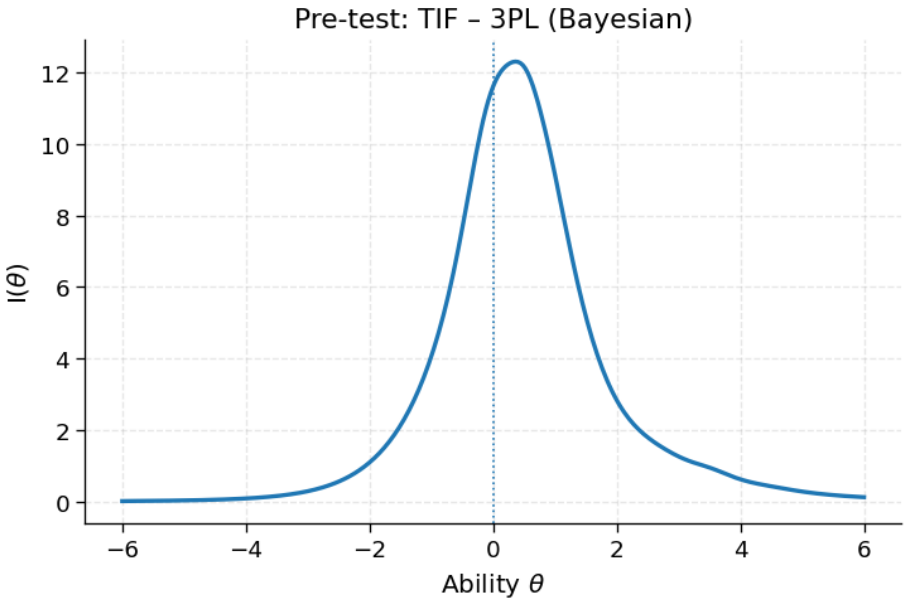
Source: Authors' computations.

Figure 15: Test 1 ICCs for Bayesian 3PL



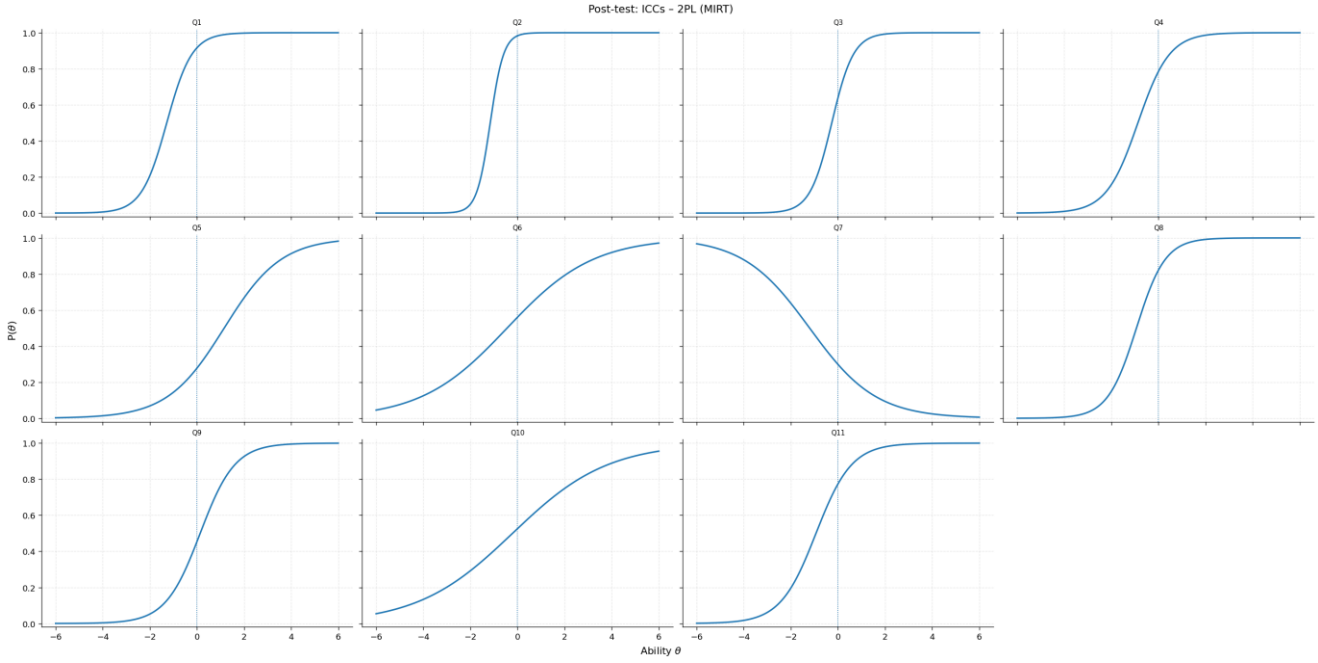
Source: Authors' computations.

Figure 16: Test 1 TIF for Bayesian 3PL



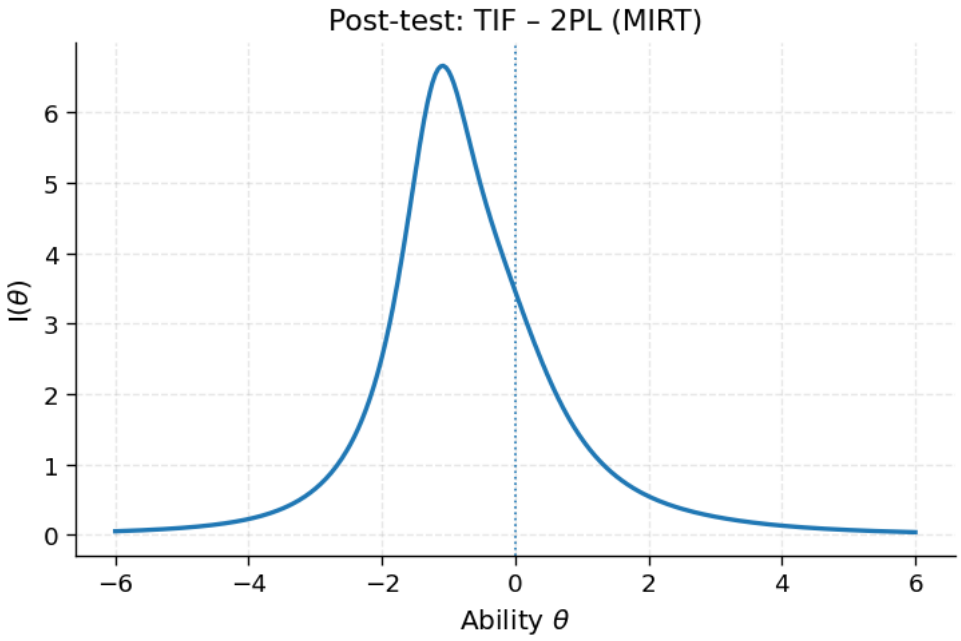
Source: Authors' computations.

Figure 17: Test 2 ICCs for 2PL



Source: Authors' computations.

Figure 18: Test 2 TIF for 2PL



Source: Authors' computations.

Figure 19: Test 2 ICCs for 3PL

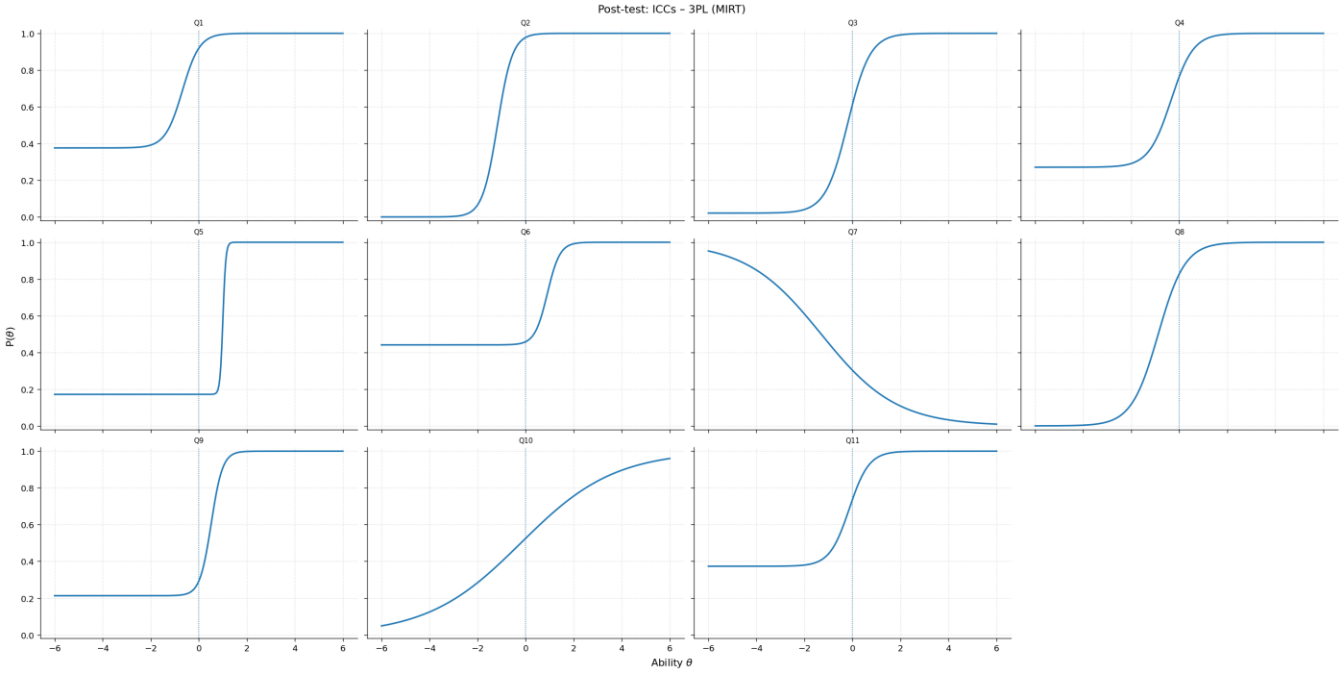


Figure 20: Test 2 TIF for 3PL

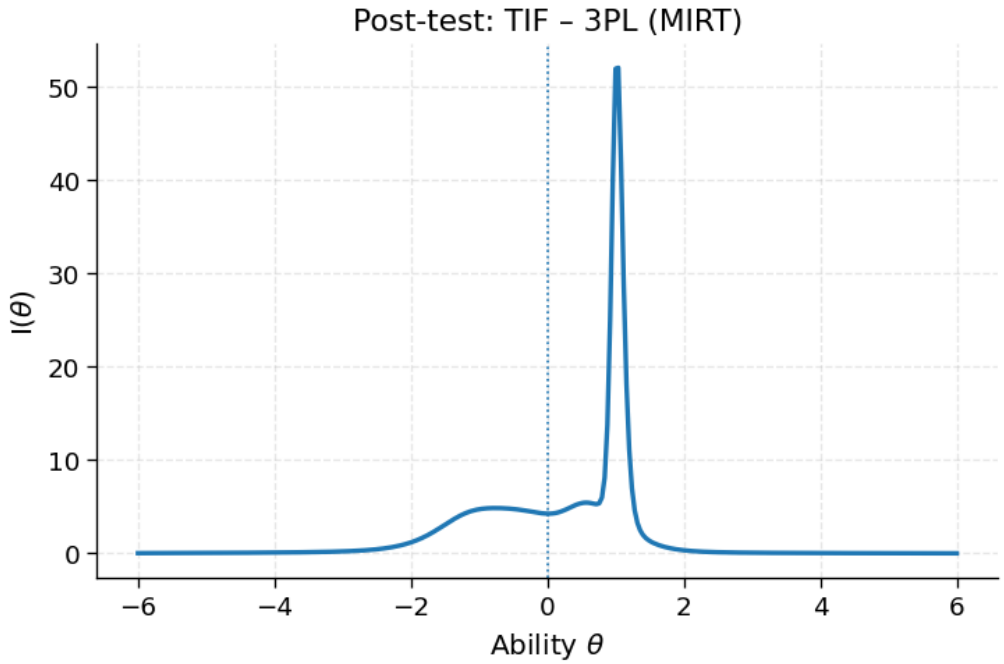


Figure 21: Test 2 ICCs for Bayesian 3PL

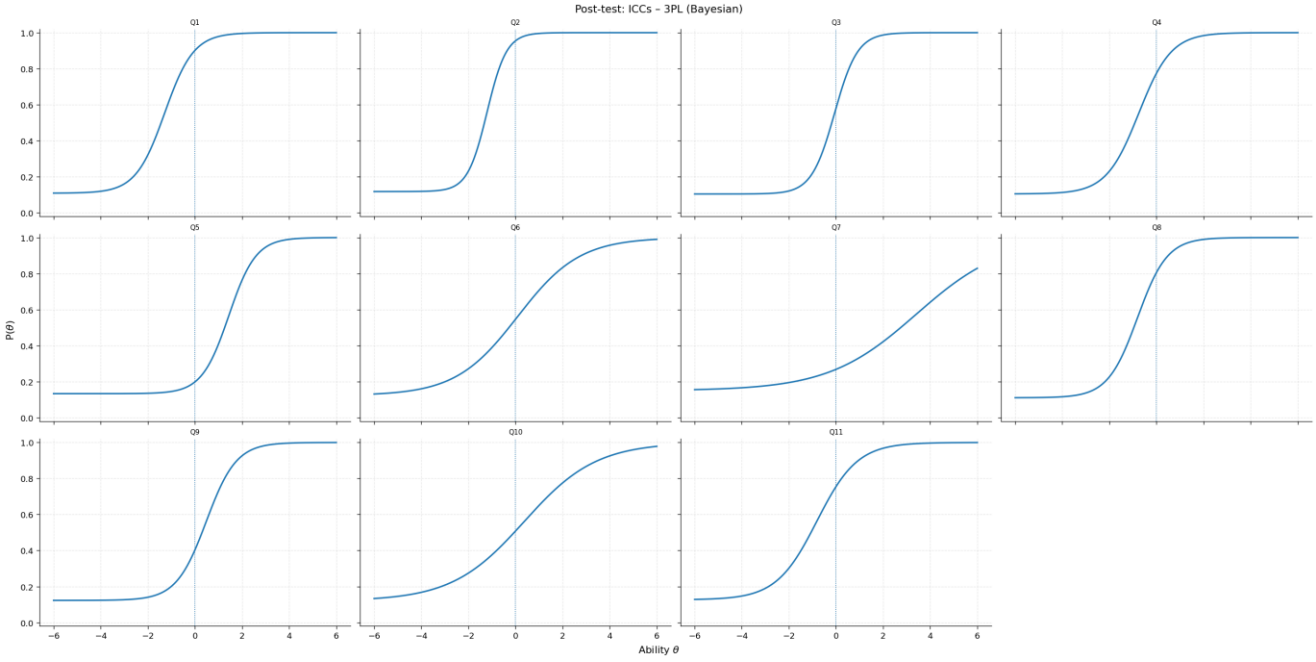
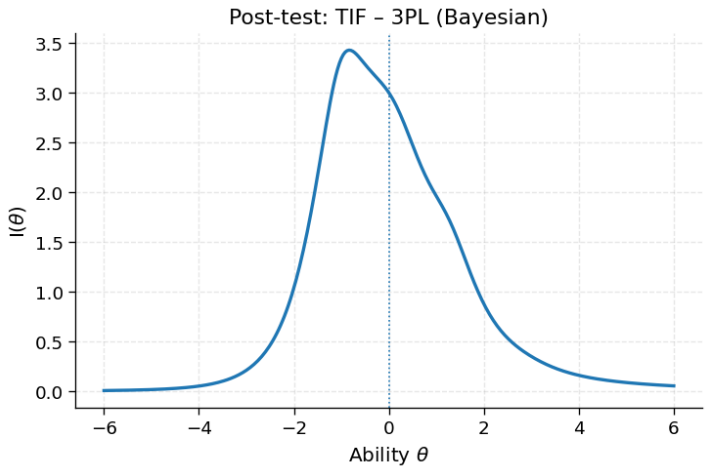


Figure 22: Test 2 TIF for Bayesian 3PL



Source: Authors' computations.

Appendix IV – Correlation Matrices

Table 11: Correlation Matrices

Variables	(1)	(2)	(3)
(1) p_theta_3PL_post	1.000		
(2) p_theta_3PL_pre_econ	0.450	1.000	
	(0.000)		
(3) p_theta_3PL_pre_legal	0.464	0.520	1.000
	(0.000)	(0.000)	
Variables	(1)	(2)	(3)
(1) p_theta_2PL_post	1.000		
(2) p_theta_2PL_pre_econ	0.448	1.000	
	(0.000)		
(3) p_theta_2PL_pre_legal	0.396	0.656	1.000
	(0.000)	(0.000)	
Variables	(1)	(2)	(3)
(1) p_theta_bayes_post	1.000		
(2) p_theta_bayes_pre_econ	0.462	1.000	
	(0.000)		
(3) p_theta_bayes_pre_legal	0.409	0.637	1.000
	(0.000)	(0.000)	

Source: Authors' computations.

Appendix V – Results for H1

Table 12: Results for Hypothesis 1

VARIABLES	p_theta_3PL_pre_legal	p_theta_2PL_pre_legal	p_theta_bayes_pre_legal	p_theta_3PL_pre_econ	p_theta_2PL_pre_econ	p_theta_bayes_pre_econ
p_theta_3PL_pre_econ	0.476***					
	(0.070)					
p_theta_2PL_pre_econ		0.600***				
		(0.062)				
p_theta_bayes_pre_econ			0.637***			
			(0.069)			
p_theta_3PL_pre_legal				0.569***		
				(0.084)		
p_theta_2PL_pre_legal					0.718***	
					(0.074)	
p_theta_bayes_pre_legal						0.637***
						(0.069)
Constant	25.687***	19.240***	18.152***	23.316***	15.792***	18.152***
	(4.275)	(3.775)	(4.005)	(4.883)	(4.316)	(4.005)
Observations	126	126	126	126	126	126
R-squared	0.271	0.431	0.406	0.271	0.431	0.406

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

Appendix VI – Results for H2

Table 13: Results for Hypothesis 2

VARIABLES	p_theta_3PL_post	p_theta_2PL_post	p_theta_bayes_post
treatment	9.018*	9.449**	8.914*
	(4.731)	(4.714)	(4.581)
p_theta_3PL_pre	0.492***		
	(0.081)		
p_theta_2PL_pre		0.496***	
		(0.080)	
p_theta_bayes_pre			0.487***
			(0.079)
Constant	21.848***	21.431***	21.392***
	(5.355)	(5.334)	(5.201)
Observations	126	126	126
R-squared	0.240	0.246	0.247

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' computations.

Table 14: Results for Hypothesis 2 Conceptual Skills

VARIABLES	p_theta_3PL_post_conceptual	p_theta_2PL_post_conceptual	p_theta_bayes_post_conceptual
treatment	6.936	8.646	8.217*
	(5.376)	(5.275)	(4.704)
p_theta_3PL_pre	0.441***		
	(0.092)		
p_theta_2PL_pre		0.473***	
		(0.090)	
p_theta_bayes_pre			0.445***
			(0.081)
Constant	29.479***	27.019***	23.855***
	(6.085)	(5.968)	(5.341)
Observations	126	126	126
R-squared	0.162	0.191	0.206

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' computations.

Table 15: Results for Hypothesis 2 Numerical Skills

VARIABLES	p_theta_3PL_post_numerical	p_theta_2PL_post_numerical	p_theta_bayes_post_numerical
treatment	7.771	7.934	6.852
	(5.026)	(4.934)	(4.769)
p_theta_3PL_pre	0.423***		
	(0.086)		
p_theta_2PL_pre		0.461***	
		(0.084)	
p_theta_bayes_pre			0.424***
			(0.082)
Constant	28.933***	26.932***	25.561***
	(5.690)	(5.582)	(5.414)
Observations	126	126	126
R-squared	0.172	0.203	0.184

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' computations.

Appendix VII – Results for H3

Table 16: Results for Hypothesis 3

VARIABLES	p_theta_3PL_post	p_theta_2PL_post	p_theta_bayes_post
p_theta_3PL_pre_econ	0.270***		
	(0.085)		

p_theta_3PL_pre_legal	0.324***		
	(0.093)		
p_theta_2PL_pre_econ		0.311***	
		(0.099)	
p_theta_2PL_pre_legal		0.184*	
		(0.109)	
p_theta_bayes_pre_econ			0.340***
			(0.102)
p_theta_bayes_pre_legal			0.192*
			(0.102)
Constant	20.438***	25.308***	23.389***
	(5.005)	(5.029)	(4.923)
Observations	126	126	126
R-squared	0.275	0.219	0.236

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

Table 17: Results for Hypothesis 3 Conceptual Skills

VARIABLES	p_theta_3PL_post_conceptual	p_theta_2PL_post_conceptual	p_theta_bayes_post_conceptual
p_theta_3PL_pre_econ	0.226**		
	(0.096)		
p_theta_3PL_pre_legal	0.316***		
	(0.105)		
p_theta_2PL_pre_econ		0.320***	
		(0.111)	
p_theta_2PL_pre_legal		0.142	
		(0.121)	
p_theta_bayes_pre_econ			0.327***
			(0.105)
p_theta_bayes_pre_legal			0.146
			(0.105)
Constant	27.125***	31.047***	26.352***
	(5.702)	(5.606)	(5.071)
Observations	126	126	126
R-squared	0.196	0.168	0.189

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Authors' computations.

Table 18: Results for Hypothesis 3 Numerical Skills

VARIABLES	p_theta_3PL_post_numerical	p_theta_2PL_post_numerical	p_theta_bayes_post_numerical
p_theta_3PL_pre_econ	0.222**		
	(0.089)		
p_theta_3PL_pre_legal	0.323***		
	(0.097)		

p_theta_2PL_pre_econ		0.259**	
		(0.102)	
p_theta_2PL_pre_legal		0.235**	
		(0.112)	
p_theta_bayes_pre_econ			0.224**
			(0.105)
p_theta_bayes_pre_legal			0.267**
			(0.105)
Constant	25.985***	28.504***	25.464***
	(5.270)	(5.170)	(5.045)
Observations	126	126	126
R-squared	0.223	0.203	0.197

Source: Authors' computations.

Appendix VIII – Two Proportion Z-Test for Attrition Rate

Table 19: Two Proportion Z-Test for Attrition Rate

Test 1 Completers	167
Test 2 Completers	126
Group A Attrition Rate:	18.52%
Group B Attrition Rate:	30.23%
Difference:	11.71%
Pooled proportion:	24.55%
Standard error:	0.0666
Z-statistic:	1.7578
P-value:	0.0788

Source: Authors' computations.