

Module 1 Summary: The Cost Problem

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Digital Finance — BSc Course

Theme: Cost (course entry point) **From prior modules:**

- None (this is the course entry module)

External knowledge assumed:

- Python basics: lists, dicts, functions; one undergraduate course
- High-school algebra and arithmetic with percentages
- Comfort reading simple cost equations

Will be introduced this module: We introduce the five-party payment model, the Merchant Discount Rate, two-sided market theory (Rochet & Tirole), and unit economics (LTV/CAC) as the cost lens for every later module.

Prerequisites are advisory; lessons remain self-contained where feasible. Forward references inside lessons flag any concept used before its canonical introduction.

L1: Anatomy of a Payment

- Five-party model: cardholder, merchant, issuer, acquirer, network
- Merchant Discount Rate (MDR) = sum of all intermediary fees
- Interchange is 60–70% of MDR

L2: Economics of Intermediation

- Two-sided market theory (Rochet & Tirole)
- Interchange regulation: EU IFR caps, US Durbin Amendment
- Distributional effects on consumers, merchants, issuers

L3: Real-Time Payments & BNPL

- BNPL: merchant pays 3–8% MDR vs. 1.5–3% for cards
- BNPL provider advances funds, bears credit risk
- Conversion uplift must exceed incremental MDR cost

L4: Platform Economics

- Customer Acquisition Cost (CAC) and Lifetime Value (LTV)
- Viable fintech: $LTV/CAC > 3.0\times$
- Revenue diversification: interchange alone is insufficient

Module 1 answers: Who pays for every payment, how much, and why?

Merchant Discount Rate (MDR)

$$\text{MDR} = \underbrace{\text{Interchange}}_{\text{to Issuer}} + \underbrace{\text{Network Fee}}_{\text{to Network}} + \underbrace{\text{Processor Fee}}_{\text{to Processor}} + \underbrace{\text{Acquirer Markup}}_{\text{to Acquirer}} + \underbrace{\text{Gateway Fee}}_{\text{to Gateway}}$$

Customer Acquisition Cost

$$\text{CAC} = \frac{\text{Total Acquisition Spend}}{\text{Number of New Customers}}$$

Unit Economics Viability

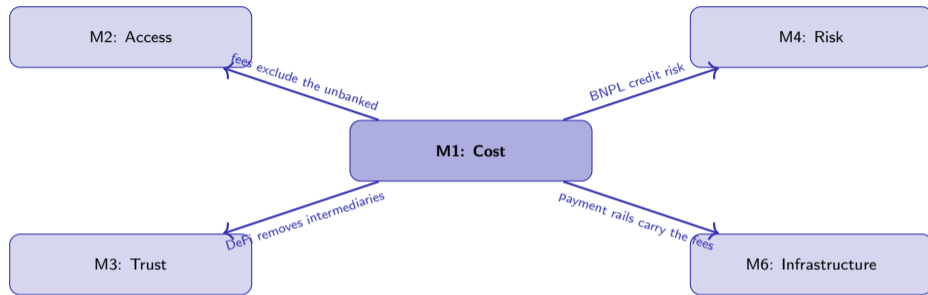
$$\text{Viable Fintech} \implies \frac{\text{LTV}}{\text{CAC}} > 3.0\times$$

BNPL Break-Even Condition

$$\text{Conversion Uplift} \times \text{Basket Size Increase} > \text{Incremental MDR Cost}$$

MDR is the central metric of Module 1 — every lesson examines who bears this cost and how to reduce it.

Connections to Other Modules



- **Cost** → **Access (M2)**: High fees and MDR exclude small merchants and low-income consumers from the formal financial system
- **Cost** → **Trust (M3)**: DeFi protocols eliminate intermediaries, reducing the fee stack to near-zero gas costs
- **Cost** → **Risk (M4)**: BNPL and P2P lending shift credit risk from banks to platforms and investors
- **Cost** → **Infrastructure (M6)**: RTGS, ACH, and SWIFT are the rails that determine settlement cost and speed

Every module in this course connects back to cost: who pays, how much, and whether technology can reduce it.

Two questions that need more than one lesson to answer:

- 1 If interchange (M1L2) is regulated downward, who pays the lost issuer revenue? Reason from M1L1 anatomy + M1L3 BNPL substitution.
- 2 Trace one euro from cardholder swipe to merchant deposit, naming every fee from M1L1 + M1L2; then explain whether a fintech replacing the issuer (M1L4) can sustain $LTV/CAC > 3$ with the residual.

Use these as study prompts before the module exam; each integrates concepts that span lessons.

Module 1: Worked Multi-Lesson Example

Worked example walks across M1L1 (five-party flow), M1L2 (MDR decomposition + IFR cap), M1L3 (BNPL price uplift), M1L4 (CAC / LTV with revenue diversification beyond interchange). **Pedagogical pattern:** the example is intentionally end-to-end. Solve it lesson-by-lesson, then step back and identify the lesson whose assumption was the binding constraint.

The exam-style version of this example appears in `extttv4/exam_prep/exam_bank.tex` for module 1.

Concepts from Module 1 that later modules will use:

- **M2L1:** MDR-as-exclusion: high merchant fees push low-margin merchants out of card acceptance
- **M3L4:** DeFi stablecoins remove issuer + acquirer from the fee stack but reintroduce other intermediaries
- **M6L1:** Real-time rails (FedNow, SEPA Instant) reshape the M1 fee distribution by removing settlement risk

Forward-pointing dependencies; concepts not in this map are local to Module 1.