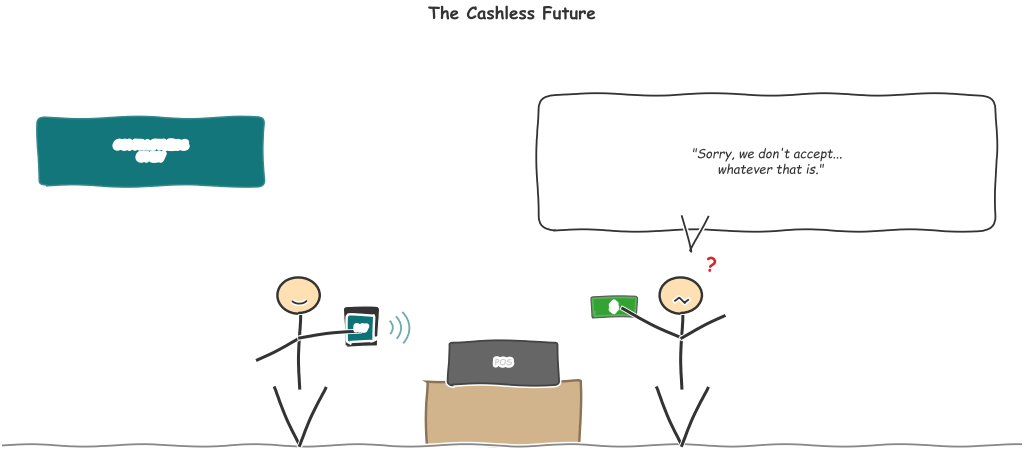
Financial Technology (FinTech) – Lecture 3

From Cash to Digital: The Transformation of Money Movement

Lecture 3 of 7 · Financial Technology (FinTech) · MSc Programme · Spring 2026

“Sorry, We Don’t Accept That”



Sweden’s cash-in-circulation fell below 1% of GDP by 2023 — yet legal tender laws still mandate its acceptance in many jurisdictions.

Learning Objectives

1. **Describe** the evolution of payment systems from barter to real-time digital rails and explain the forces driving each transition. [Understand]
2. **Explain** the four-party payment model and the authorization, clearing, and settlement lifecycle for card-based transactions. [Understand]
3. **Apply** a cost-analysis framework to compare merchant fees across payment types and evaluate the impact of interchange regulation. [Apply]
4. **Analyse** how cross-border payment complexity and remittance costs affect financial inclusion in developing economies. [Analyse]
5. **Evaluate** the design trade-offs in central bank digital currencies and real-time payment rails as future payment infrastructure. [Evaluate]

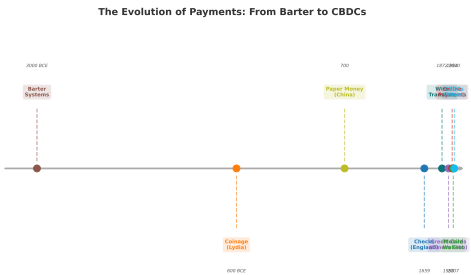
Bloom's levels covered: Understand $\rightarrow$ Apply $\rightarrow$ Analyse $\rightarrow$ Evaluate

These objectives map directly to the quiz and workshop assessments for this lecture.

Building on L02 – From Ecosystem to Infrastructure

Where we left off (L02):

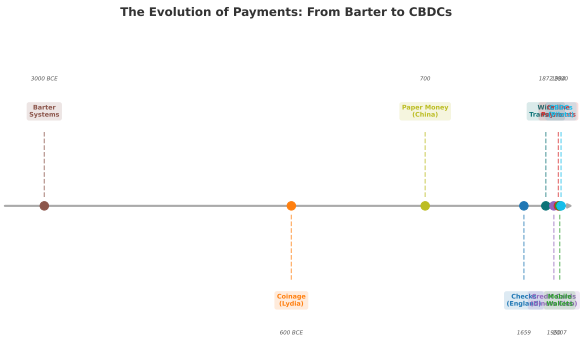
- Fintech adoption is shaped by trust, nudging, and choice architecture
- The inclusion–protection trade-off has no free solution
- Behavioural design determines who the ecosystem serves



Where we go today (L03):

- *How* do payments actually flow from tap to settlement?
- What **costs and frictions** define the current system?
- How can **real-time rails and CBDCs** reshape money movement?

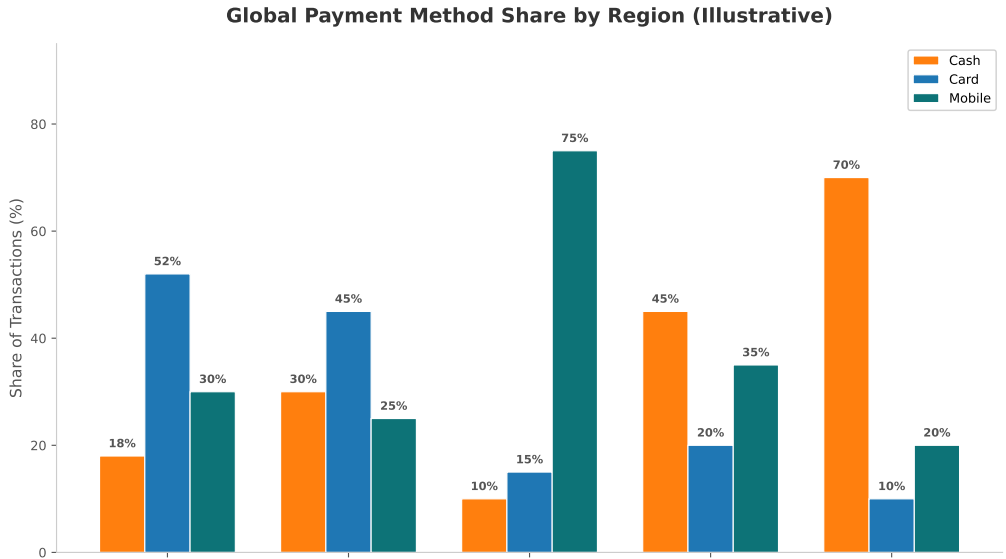
From Barter to Digital – The Arc of Payment History



Six pivotal transitions:

- **Barter** (pre-3000 BCE) – requires double coincidence of wants
- **Coinage** (c. 600 BCE) – portable standardised value
- **Paper money** (c. 1000 CE) – trust shifts to the issuer
- **Cheques and wires** (17th–19th c.) – non-physical transfer
- **Payment cards** (1950) – intermediated credit at sale
- **Digital and mobile** (2007–present) – from plastic to software

The Global Payment Landscape



Why Cash Persists in a Digital World

Despite the digital transition, cash remains dominant by transaction *count* in most economies. Four forces sustain it:

User-side rationales:

- **Anonymity** – cash leaves no digital trail; cited by 25% of Europeans as a primary motive (ECB, 2022)
- **Reliability** – works without electricity or connectivity; the payment method of last resort
- **Budgeting** – tangible "envelope method" provides spending limits digital payments lack

Merchant-side rationale:

- **Zero marginal cost** – no interchange fees, no terminal costs. For micro-transactions, cash is cheapest

The Policy Tension

Eliminating cash without universal digital access creates a new form of financial exclusion – disproportionately affecting the elderly, rural populations, and the poor.

ECB (2022): 59% of eurozone point-of-sale transactions were in cash by count, though their share of total value was only 24%.

The Behavioural Dimension – The Pain of Paying

Think about the last time you paid for something expensive with **cash** — peeling off banknotes, watching your wallet thin. Now compare that to tapping your phone. The amount was the same. The pain was not.

Prelec and Loewenstein (1998) identify three drivers of **payment pain**:

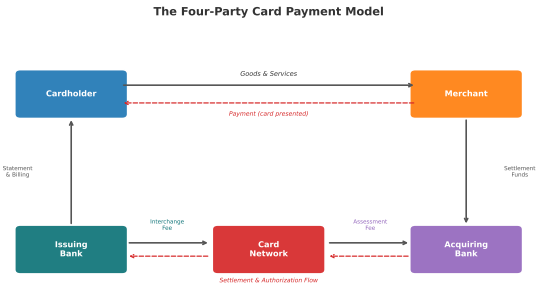
- **Salience:** Cash is tangible; digital payments are abstract. Less salience means less pain.
- **Temporal coupling:** When payment and consumption are simultaneous, pain is highest. Credit decouples them.
- **Form of payment:** Physical currency activates loss aversion more strongly than electronic

Why This Matters for Design

Payment system designers choose how much pain to remove. Removing too much friction reduces spending deliberation. L02's choice-architecture lens applies directly to every tap-to-pay decision.

Credit card spending exceeds equivalent cash spending by 12–18% for identical purchase decisions (Soman, 2003).

The Four-Party Payment Model



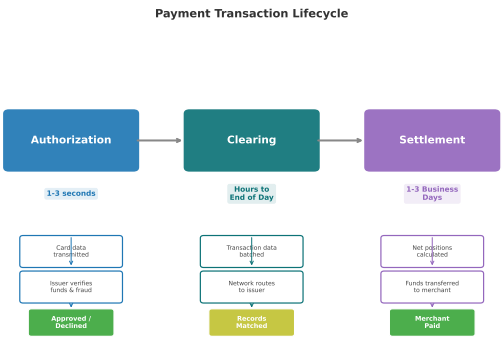
The card payment ecosystem involves four principals:

- **Cardholder** – initiates the transaction
- **Issuer** – cardholder's bank; extends credit or debit access; bears fraud risk
- **Acquirer** – merchant's bank; processes the transaction; manages merchant risk
- **Network** (Visa, Mastercard) – sets rules, routes messages, guarantees interoperability; holds no funds

Key Insight

The network is a two-sided platform: it

Authorization, Clearing, and Settlement

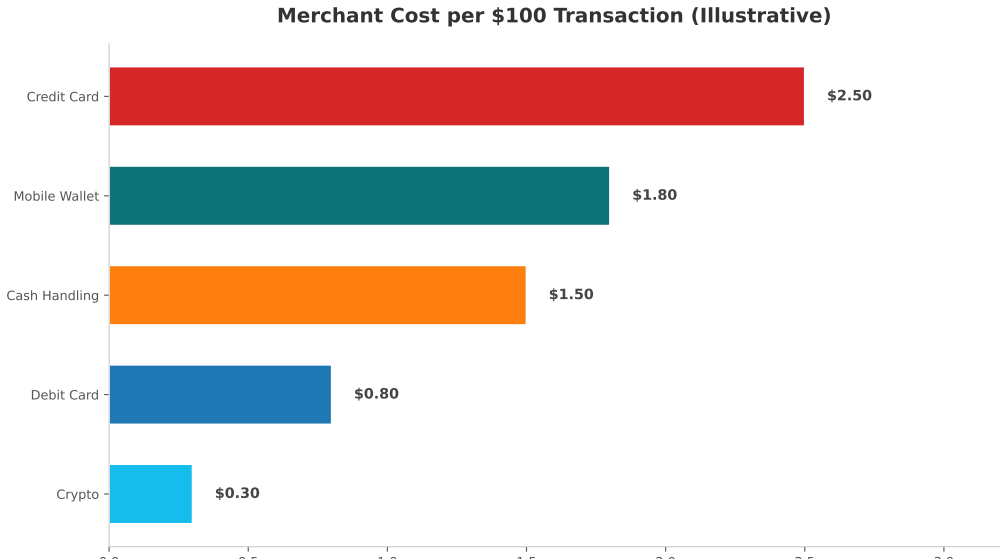


Every card transaction passes through three stages:

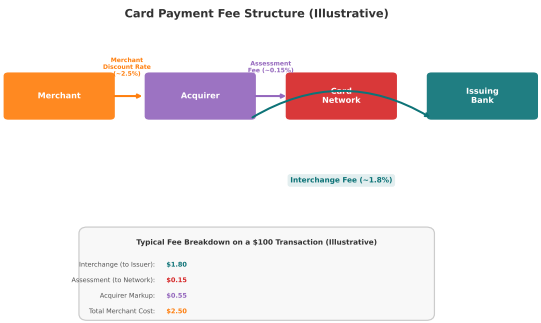
1. **Authorization** (milliseconds) – the issuer checks identity and available funds and places a hold.
2. **Clearing** (hours to one day) – transaction details are exchanged between acquirer and issuer via the network; net positions are calculated.
3. **Settlement** (one to three days) – actual funds transfer between banks; the merchant receives funds minus fees.

The gap matters: Between authorization

The Merchant Cost Burden



Interchange Fees – The Hidden Cross-Subsidy



The interchange fee flows from the **acquirer to the issuer** on every transaction:

- **Economic rationale:** Compensates the issuer for fraud risk, the interest-free period, and maintaining the cardholder relationship
- **Set by networks:** Visa and Mastercard publish hundreds of rate categories by card type, merchant category, and channel
- **Not negotiable:** Merchants can only negotiate the acquirer's markup *above* interchange

International Credit Card Regulation – A Patchwork

Interchange regulation has spread globally but with widely varying approaches:

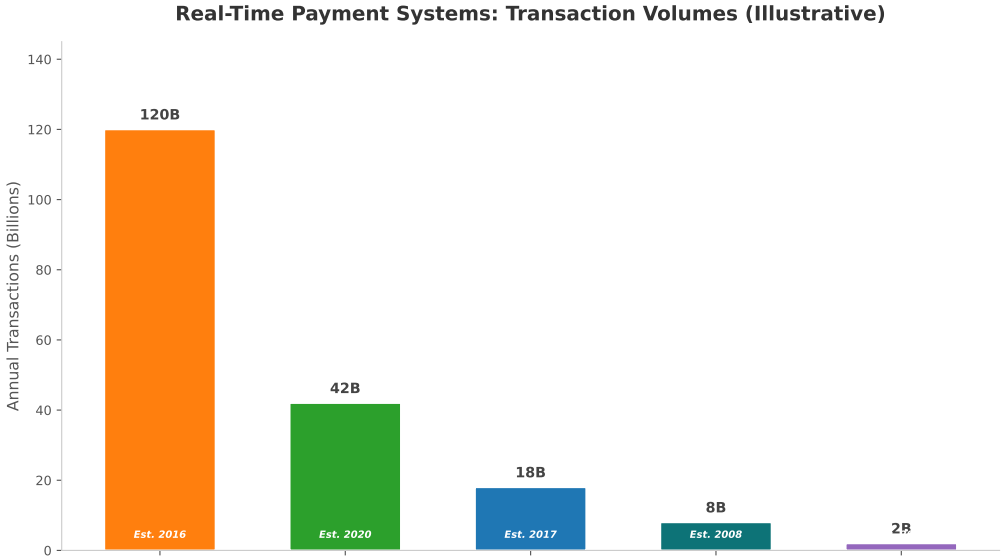
Jurisdiction	Debit Cap	Credit Cap
EU / EEA	0.20%	0.30%
Australia	0.08 AUD avg	0.50% avg
USA (Durbin)	21c + 0.05%	No cap
India (UPI/RuPay)	0%	0%
China	0.35% max	0.45% max
UK (post-Brexit)	0.20%	0.30%

India is the only major economy with zero interchange — subsidised by government as inclusion policy.

The regulatory dilemma:

- Pro-regulation: Interchange is a hidden tax; caps lower merchant costs and improve price transparency
- Anti-regulation: Caps reduce issuer revenue, leading to fewer card benefits, higher account fees, and reduced credit availability for marginal borrowers
- **Evidence:** EU interchange regulation (IFR, 2015) reduced merchant costs by approximately EUR 5 billion annually, but consumer price pass-through has been incomplete and slow

Real-Time Payments – A Global Revolution



Batch Settlement vs. Real-Time – What Changes?

Why traditional settlement takes days:

- **Netting efficiency:** Batch settlement allows bilateral netting, reducing interbank transfer volume by 80–90%
- **Fraud windows:** The delay allows chargeback initiation and dispute resolution
- **Liquidity management:** Banks prefer predictable scheduled settlement over continuous real-time obligations

What real-time systems require:

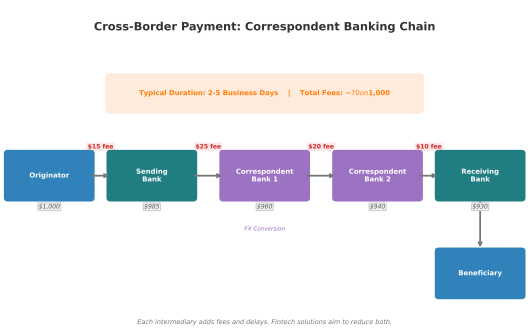
- Pre-funded accounts or central bank liquidity facilities
- Real-time fraud detection with no chargeback window
- 24/7/365 operational infrastructure
- Irrevocability – once settled, funds cannot be recalled

The Core Trade-off

Real-time settlement trades fraud protection and netting efficiency for speed and finality.

The UK Faster Payments system processes over 4 billion transactions annually with real-time settlement and fraud rates comparable to legacy batch systems.

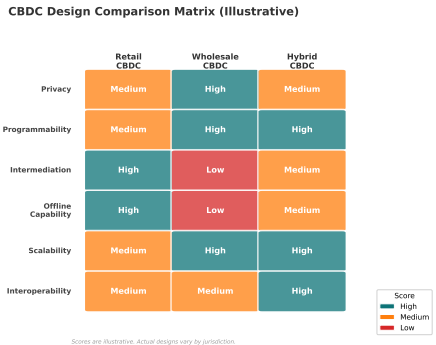
Cross-Border Payments – The Broken Corridor



Cross-border payments remain the most expensive, slowest, and least transparent segment of the payment system:

- **Correspondent banking:** Most payments traverse a chain of intermediary banks, each adding fees, delays, and opacity
- **SWIFT:** A messaging network only – actual settlement occurs through nostro/vostro account relationships
- **FX conversion:** Each hop may involve an opaque markup of 1–4% above mid-market rates
- **Compliance:** AML/KYC checks add

Central Bank Digital Currencies – Design Trade-offs



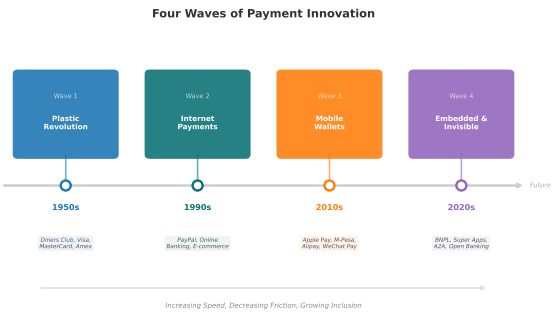
CBDCs are digital liabilities of a central bank:

- **Retail CBDC:** Digital cash for consumers; direct claim on the central bank; raises bank disintermediation risk
- **Wholesale CBDC:** Restricted to financial institutions for interbank settlement; less disruptive, more immediately practical

Key design dimensions:

- Account-based vs. token-based
- Interest-bearing vs. non-interest
- Full anonymity vs. full traceability

Where Are We Heading? The Innovation Timeline



The end state of payment innovation is the **disappearance of the payment moment itself**:

- **One-click and in-app:** Checkout friction eliminated; conversion rises 5% per friction step removed
- **Ride-hailing model:** Payment embedded in the service – the passenger never consciously "pays"
- **Subscriptions:** Recurring charges made invisible; churn reduced through payment invisibility
- **IoT payments:** Connected cars paying tolls, machines ordering their

Real-Time Payment Systems – Three Lessons

UPI (India)

Model: Account-to-account via virtual payment address. Interoperable across all banks.

Cost: Zero (government-subsidised).

Scale: 12B+ transactions/month.

Lesson: Mandate + zero cost = explosive adoption.

PIX (Brazil)

Model: Instant via CPF, phone, email, or QR code. Central bank operated.

Cost: Free for individuals.

Scale: 150M+ users in 2 years.

Lesson: Central bank infrastructure can leapfrog card networks.

FedNow (USA)

Model: Bank-to-bank instant settlement. Voluntary participation.

Cost: Banks set consumer pricing; no mandated zero fee.

Scale: Fewer than 1,000 banks by end 2024.

Lesson: Voluntary adoption in a card-dominated market is slow.

The contrast between UPI/PIX (government-mandated, zero-cost) and FedNow (voluntary, market-priced) illustrates how policy design determines adoption speed.

Fixing Cross-Border – Emerging Alternatives

Remittances: the inclusion angle

- USD 656 billion flows to LMICs annually (World Bank, 2022)
- Average transaction: USD 200–500; average cost: 6.2%
- Sub-Saharan Africa: 7.9% average; some corridors exceed 15%
- Every 1% reduction releases USD 6.5B annually for recipient families

Emerging alternatives:

- **Wise:** Peer-to-peer matching of opposite-direction flows; avoids correspondent chain for major corridors
- **UPI-PayNow link:** Direct India–Singapore account-to-account across borders; bilateral rail integration
- **Project mBridge:** Multi-CBDC bridge (BIS Innovation Hub) connecting central banks for wholesale settlement
- **Stablecoins:** On-chain settlement in minutes; USD 7T transacted in 2023, mostly institutional

The SDG Target

A Payment Evaluation Framework

Five questions to evaluate any payment system or innovation:

1. **Who bears the cost?**
   Is the cost visible to the payer, hidden in merchant prices, or subsidised by government?
2. **What is the settlement finality?**
   When does the recipient have irrevocable access to funds?
3. **How does it handle failure?**
   Who absorbs fraud losses, chargebacks, and errors?
4. **Who is excluded?**
   Bank account, smartphone, identity documents, internet access?

Applying the framework:

Cash

Cost: payer. Finality: instant. Failure: bearer risk. Exclusion: none. Behaviour: high spending awareness.

Credit Card

Cost: merchant (interchange). Finality: T+1 to T+3. Failure: chargeback (consumer protected). Exclusion: credit score required. Behaviour: reduced payment pain.

UPI / PIX

"Every design choice that reduces payment friction also reduces spending deliberation."

Speed and inclusion benefits:

- Real-time settlement removes merchant working capital risk
- Zero-fee rails (UPI, PIX) include the unbanked at scale
- Reduced cross-border costs free household income in LMICs
- Embedded payments increase conversion and adoption

Speed and inclusion costs:

- Irrevocable settlement eliminates chargeback consumer protection
- Frictionless payment reduces spending awareness (pain of paying)
- Government rail monopolies remove market competition incentives
- Zero-cash markets exclude populations without digital access

No Free Lunch

Evaluating Payment System Health – Five Indicators

1. **Cost distribution:** Are payment costs borne by those who benefit, or are they hidden and regressive?
2. **Settlement finality:** How quickly does the recipient have *irrevocable* access to funds – and what is traded off for that speed?
3. **Access breadth:** Does the system require a smartphone, a bank account, a credit score? Each prerequisite is an exclusion mechanism.
4. **Resilience:** Does the system function without connectivity, during outages, or across borders? Single points of failure are systemic risks.
5. **Behavioural alignment:** Do payment friction levels match what users need for deliberate financial decision-making?

These five indicators apply to any payment system – from M-Pesa to FedNow to a proposed CBDC. Use them in Workshop C.

Apply these indicators to a payment system you use. Which indicator reveals the sharpest weakness? Bring your analysis to the workshop.

The Central Tension of Payment Innovation

**"Payment infrastructure is not neutral.
Every design choice allocates costs, risks, and power."**

- Will interchange economics shift from merchants to networks to governments?
- Will real-time rails be public utilities (UPI/PIX) or private toll roads (FedNow)?
- Will CBDCs expand central bank surveillance or extend financial access?
- Will embedded payments liberate consumers or erode their spending control?

These are not **technology** questions. They are governance and ethics questions answered through infrastructure design.

Return to this tension after L04 (Regulation) and L07 (Technology). Each lecture adds a layer to the answer.

What Comes Next

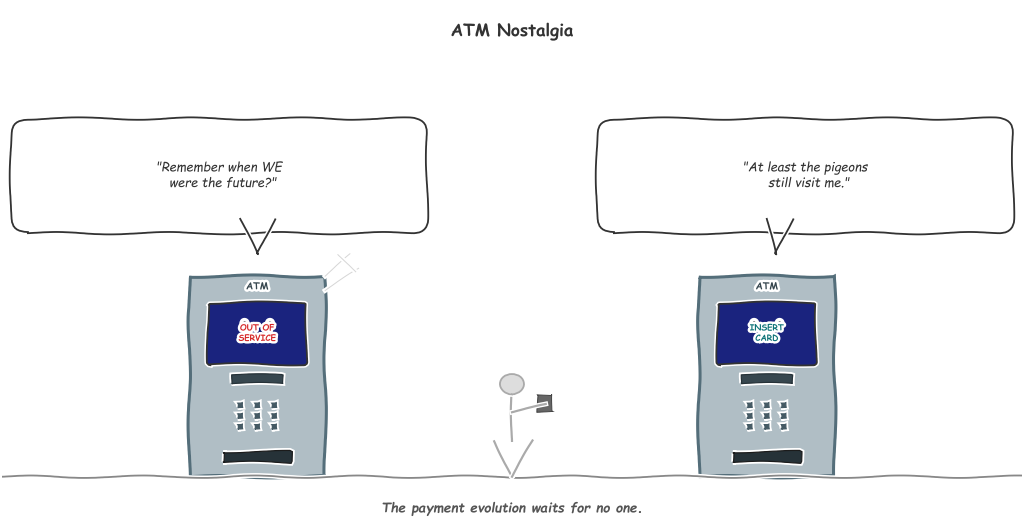
- **Next: L04 (Fintech Security and Regulation – RegTech)**
  How regulators are responding to the payment innovations discussed today. AML/KYC automation, regulatory sandboxes, and the rise of supervisory technology.
- **Before L04, reflect:**
  - Trace your last online purchase from tap to settlement. How many intermediaries touched your money? What did each charge?
  - Could that transaction have been routed more cheaply?
- **Workshop C preparation:** Apply the five payment system health indicators (Frame 23) to one payment method you use regularly. Bring a two-paragraph evaluation to class.

Course Arc

L01: Foundations → L02: Ecosystem → **L03: Payments** → L04: Regulation → L05: Wealth → L06: Insurance → L07: Technology

All lecture slides and workshop case materials are available on the course website.

“Remember When We Were the Future?”



Global ATM numbers peaked in 2018 and have been declining since. The UK alone lost over 15,000 ATMs between 2015 and 2023.

Key Takeaways

1. **History is dematerialisation:** Every payment transition increased abstraction and shifted trust from the medium to the institution behind it
2. **Four-party model:** Card payments flow through issuer, acquirer, network, and merchant. Understanding this chain is essential to understanding payment costs
3. **Settlement is not instant:** Authorization takes milliseconds; traditional settlement takes days. Real-time systems close this gap but trade fraud protection for speed
4. **Payment costs are regressive:** Small merchants pay the highest effective rates. Interchange is a hidden cross-subsidy from merchants to cardholders – and ultimately to all consumers
5. **Cross-border payments remain broken:** Average remittance costs of 6.2% represent a multi-billion-dollar burden on the world's poorest populations
6. **CBDCs force design choices:** Privacy vs. traceability, retail vs. wholesale, interest vs. non-interest. No single design satisfies all objectives simultaneously
7. **Invisible payments remove friction:** Embedded payments maximise convenience but eliminate behavioural friction that supports deliberate spending control

Summary and Key Vocabulary

Lecture Summary

Payment systems are the circulatory system of the financial economy – and they are undergoing their most profound transformation since the invention of the credit card. Real-time domestic rails are replacing batch settlement, open banking is challenging card network dominance, and CBDCs and stablecoins are redefining what money means in the digital age. Yet cross-border payments remain slow and expensive, interchange economics disproportionately burden small merchants, and the progressive invisibility of payments raises behavioural concerns about spending control. The central lesson is that **payment system design is not merely an engineering problem – it is a policy choice that determines who pays, who profits, and who is excluded.**

- **Four-Party Model**
- **Interchange Fee**
- **Authorization / Clearing / Settlement**
- **Cross-Border Remittance**
- **Open Banking (PSD2)**
- **CBDC (Retail / Wholesale)**