Payment Systems Economics

L04: Economics of Value Transfer

Why sending money abroad costs 6% and takes 3 days—and how technology is changing that

Economics of Digital Finance

BSc Course

Lesson Overview

Today's Topics

1. Economics of payment systems
2. Network effects and adoption
3. Two-sided market theory (how platforms like Visa balance merchants and consumers)
4. Cross-border payment challenges
5. Financial inclusion

Learning Objectives

- Apply network economics to payments
- Analyze interchange fee economics (the hidden fees merchants pay every time you use a credit card)
- Understand correspondent banking costs
- Evaluate digital solutions

Payment systems are infrastructure for economic activity; their economics matter. No prior economics required—all terms explained.

Economics of Payment Systems

Economic Functions

Payment systems enable:

- Value transfer between parties
- Settlement of obligations *(the final, irreversible transfer of money between parties—once settled, it cannot be undone)*
- Support for economic transactions

Key Economic Properties

- Network goods (products that become more valuable as more people use them)
- Infrastructure characteristics (shared systems everyone uses, like roads or power grids)
- Significant fixed costs (costs that doń t change with volume—building the system costs the same for 1 or 1 million payments)

System Types

Large Value (Wholesale)

- Fedwire (US system handling $5 trillion/day—mostly between banks), TARGET2 (EU equivalent)
- RTGS (Real-Time Gross Settlement): each payment settles individually and immediately
- Low volume, high value

Retail

- Cards, ACH (Automated Clearing House—processes payroll deposits, bill payments, and bank transfers in batches, usually overnight), instant payments
- High volume, lower value
- Consumer-facing

Payment systems exhibit natural monopoly characteristics (one provider can serve everyone cheaper) due to network effects

Network Effects in Payments

Direct Network Effects
Value increases with users:

$$V(n) = n \cdot v(n)$$

(Total value = number of users times value per user.) where $v(n)$ is per-user value. **The key insight:** $v(n)$ *increases* with n. For a regular product (e.g., a toaster), value per unit is constant. For a network (e.g., Venmo), each user becomes more valuable as more people join—a virtuous cycle.

Metcalfe's Law (simplified)

$$V \propto n^2$$

($\propto$ means "is proportional to" or "grows with") (Value grows with the square of users: 10 users = 100 units of value, 100 users = 10,000 units. This explains why dominant networks stay dominant.) (Real example: Venmo 2012: 10,000 users. Venmo 2023: 90 million users. Same app, 9,000x more useful.)

- Each user can transact with $n - 1$ others

Implications for Payments

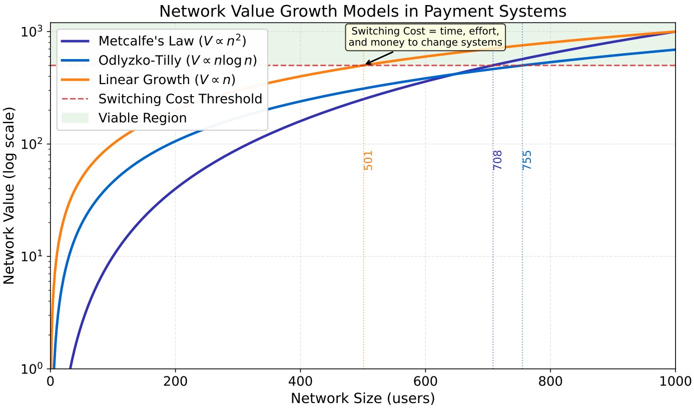
Adoption Dynamics

- Critical mass threshold (minimum users needed before network becomes self-sustaining)
- Tipping points (moments when adoption suddenly accelerates) *(Rogers (1962) showed: below ∼16% ("early adopters"), must convince each user individually. Above 16%: social proof kicks in and adoption accelerates)*
- Winner-take-most markets (where one or two players capture most market share)

Entry Barriers

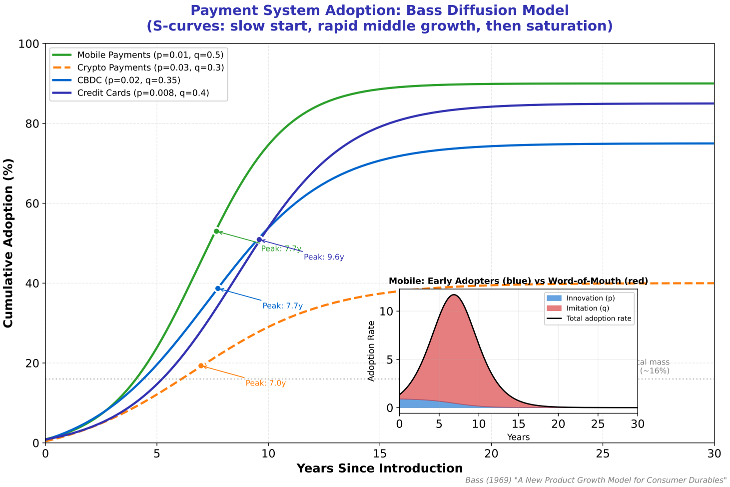
- Incumbents (existing dominant players) have user base advantage
- New entrants need to "buy" network
- Interoperability *(ability for different payment systems to work together)* can reduce barriers

Network Value Growth: Metcalfe's Law vs. Alternatives



- **Metcalfe's Law** ($V \propto n^2$) predicts explosive growth—network with strong effects reaches critical mass (the switching-cost threshold) far sooner than linear growth
- The **Odlyzko-Tilly** model ($V \propto n \log n$) is more conservative: not every new connection is equally valuable, so growth is fast but not quadratic
- **Practical implication:** Whichever model holds, payment networks with genuine network effects dominate within hundreds of users, not millions—explaining early mover advantage

Payment Technology Adoption Patterns



S-curve adoption: slow start, rapid growth after critical mass (~16%—once 1 in 6 people use something, social proof accelerates adoption), then saturation

Two-Sided Market Theory: The Concept

The Platform Model

Card networks connect:

- Side 1: Cardholders (consumers)
- Side 2: Merchants (acceptors)
- Platform: Visa, Mastercard

Cross-Side Network Effects

(Cross-side: each side benefits when the OTHER side grows—different from direct network effects where users benefit from more of the SAME type of user)

- More merchants → more cardholders
- More cardholders → more merchants
- Chicken-and-egg problem

Key Insight

Price structure matters, not just level:

- Subsidize price-sensitive side
- Charge price-insensitive side
- "Get both sides on board"

(Fee breakdown: Of $2 merchant fee on $100 purchase, $1.80 goes to your bank as interchange, $0.20 to Visa)

Beyond Payments

(This framework explains Uber, Airbnb, Amazon, dating apps—any platform connecting two groups)

Rochet & Tirole (2003): Two-sided markets require analysis beyond standard economics

Two-Sided Market Theory: Rochet-Tirole Pricing Model

Rochet-Tirole Model *(Tirole received the 2014 Nobel Prize in Economics)*
Total price constraint:

$$p_B + p_S = c + m$$

where c is total cost per transaction ($c = c_B + c_S$, split between serving buyers and sellers) and m is the platform's profit margin.

Optimal price ratio:

$$\frac{p_B - c_B}{p_S - c_S} = \frac{\eta_S}{\eta_B}$$

(Charge more to the side that's less price-sensitive.)
where η = price elasticity (how much demand changes when price changes—elasticity of 2 means a 1% price increase causes a 2% demand drop)

Worked Example

Example: Suppose merchant elasticity $\eta_S = 0.5$ (merchants are trapped—they must accept cards) and consumer elasticity $\eta_B = 2.0$ (consumers can switch to cash).

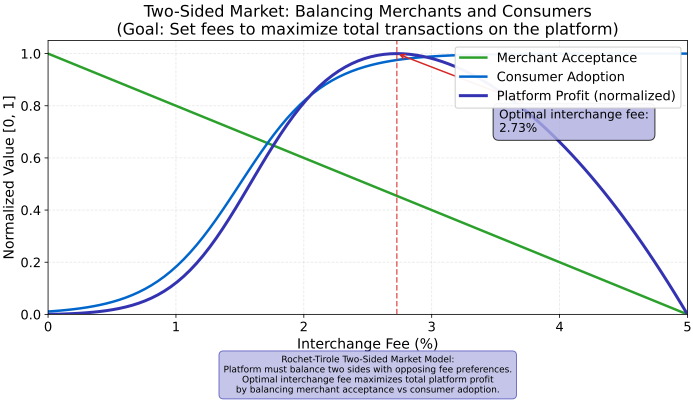
$$\frac{p_B - c_B}{p_S - c_S} = \frac{0.5}{2.0} = 0.25$$

This means the markup on consumers should be **one-quarter** of the markup on merchants. Result: cardholders pay zero or negative fees (rewards!) while merchants pay 2–3%.

Real-world check: Visa charges cardholders $0 annual fee (often with cashback), but merchants pay 1.5–3% per transaction. The math matches reality.

The elasticity ratio explains why YOUR card is free but the coffee shop pays Visa 2% on every sale

Interchange Fee Optimization: Balancing Both Sides



- As the interchange fee rises, **merchant acceptance falls** (green) but **consumer adoption rises** (blue, because higher fees fund better rewards)
- **Platform profit** (purple) peaks at the optimal fee where the product of both sides is maximized—set the fee too low and consumers leave; too high and merchants leave
- The red line marks the profit-maximizing interchange fee—in practice, Visa/Mastercard set fees near this optimum

This chart visualizes the Rochet-Tirole model: the platform's problem is finding the fee that keeps BOTH sides on board

Interchange Fee Economics

The Fee Flow

1. Consumer pays $100
2. Merchant receives $97-98
3. Interchange: 1.5-2% to issuer (bank that gave you the card)
4. Network fee: 0.1-0.2%
5. Acquirer (merchant's bank) margin: 0.2-0.5%

Economic Rationale

- Issuer bears fraud risk (refunds you when your card is stolen—needs compensation for that risk)
- Subsidizes cardholder rewards
- Balances two-sided market

Regulatory Debate

Against High Interchange

- Merchants pass costs to prices
- Regressive (poorer cash users subsidize wealthier card users through higher prices) *(Mechanism: Merchant raises all prices 2%; cash customer pays higher price but gets no rewards)*
- Centralized fee-setting (interchange fees are set by Visa/Mastercard, not negotiated between individual banks—critics argue this resembles price-fixing)

For Market Rates

- Funds card benefits
- Network competition exists
- Caps reduce innovation

EU capped interchange at 0.2-0.3%; US Durbin Amendment (2010 law) capped debit at 0.05%+21c but left credit uncapped—debit was capped because issuers bear less risk (money is already in your account), while credit remains uncapped because banks bear default risk.

Cross-Border Payment Challenges

The Problem

As we discussed in L03 (CBDCs), cross-border payments are:

- Expensive: 6%+ average cost (send $100, only $94 arrives)—now we examine *why*
- Slow: 2-5 days settlement
- Opaque: uncertain fees
- Fragmented: many intermediaries

Root Causes

- Lack of common infrastructure
- Regulatory fragmentation
- Legacy technology
- Correspondent banking model (payments routed through intermediary banks) *(Each bank: maintains relationship, holds capital, performs compliance, takes profit = costs multiply)*

Economic Inefficiencies

FX (Foreign Exchange) Costs

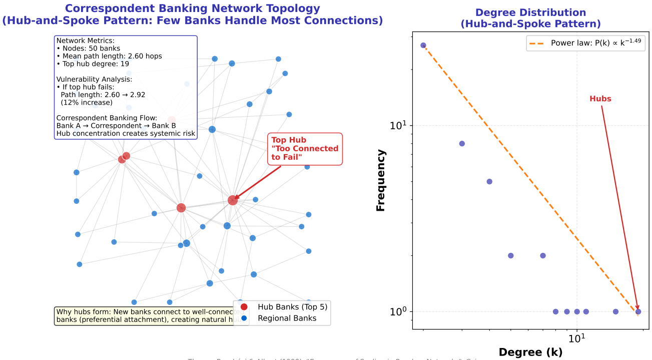
- Wide bid-ask spreads (gap between buy and sell prices)
- Hidden markups in rates
- Multiple conversions

Compliance Costs

- AML (Anti-Money Laundering) / KYC (Know Your Customer) checks at each hop
- Sanctions screening (checking if recipients are on government blacklists of terrorists or banned countries)
- Data format inconsistencies

G20 target: reduce average cost to 3% by 2027; currently at 6%+

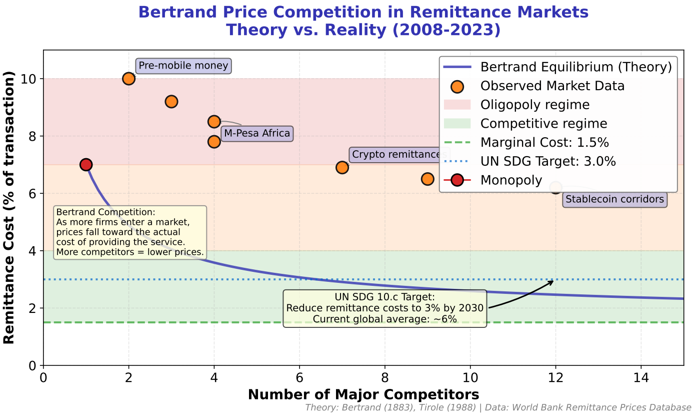
Correspondent Banking Network



Theory: Barabási & Albert (1999), "Emergence of Scaling in Random Networks", Science

Hub-and-spoke model adds costs and delays; each intermediary takes fees. Example: $1,000 US to Kenya = $80+ lost across 4 intermediaries

Remittance Costs: The Scale of Inefficiency



High-cost corridors (Africa) hurt poorest populations most; digital can reduce costs

Settlement System Design

RTGS (Real-Time Gross Settlement)

Characteristics:

- Immediate, final settlement
- Each transaction settled individually
- High liquidity requirement (banks must hold more cash)

Examples: Fedwire, TARGET2

Trade-offs:

+ Eliminates settlement risk (risk one party pays but other defaults) *(Your rent payment: RTGS = clears instantly; DNS = might take days, risk if bank fails mid-batch)*
- High liquidity cost

DNS (Deferred Net Settlement)

Characteristics:

- Batch settlement at intervals
- Payments netted (offsetting opposite payments so only difference settles)
- Lower liquidity needs *(Example: A owes B $5M, B owes A $4M. DNS: settle net $1M in one transfer. RTGS: two separate transfers ($5M + $4M = $9M total flowing through the system))*

Examples: ACH, many retail systems

Trade-offs:

+ Liquidity efficient
- Settlement risk until batch

Hybrid systems combine benefits: queue management (holding payments in line until funds arrive), partial netting (offsetting some payments while settling others individually) with RTGS speed

Instant Payments: Economic Impact

Global Rollout

Major systems:

- UK: Faster Payments (2008)
- India: UPI (Unified Payments Interface, 2016)
- EU: SEPA (Single Euro Payments Area) Instant (2017)
- US: FedNow (2023)—a **public** system competing with the private RTP network *(Same public-vs-private question as CBDCs in L03. US was late: thousands of fragmented banks made coordination hard; existing systems were "good enough" for incumbents)*

Design Features

- 24/7/365 availability
- Settlement in seconds
- Irrevocable payments *(cannot be reversed or cancelled once sent)*

Economic Benefits

For consumers:

- Improved cash flow management
- Emergency transfers
- P2P (person-to-person) payments

For businesses:

- Working capital (cash needed for daily operations) optimization
- Reduced float costs (money sitting in transit earns interest for intermediaries—instant payments eliminate this)
- Real-time reconciliation *(matching payments to invoices instantly)*

For economy:

- Velocity of money (how fast money circulates—faster = more economic activity) increase
- Reduced payment friction

India's UPI: 10+ billion transactions/month; transformed payment landscape

Financial Inclusion Economics

Building on the L03 inclusion discussion, here we examine M-Pesa—financial inclusion WITHOUT a CBDC.

The Unbanked

1.4 billion adults lack accounts:

- Documentation barriers
- Physical access (branches)
- Minimum balance requirements
- Trust and literacy issues

Economic Costs

- Check cashing fees (2-5%)
- No savings accumulation
- Excluded from credit (cannot get loans, credit cards, or mortgages without a bank account) *(Even in rich countries: 5.4% of US households are unbanked and pay $40+/month in check-cashing fees)*

Mobile Money Success

M-Pesa (Kenya) model:

- Agent network (not branches)
- Phone-based (no smartphone needed)
- Low-value, low-cost transactions *(M-Pesa fees: Sending $8 costs $0.09 (1.1%) vs Western Union $5 minimum = 62% on small amounts)*

Impact Evidence

- Suri & Jack (2016): 2% poverty reduction (approximately 400,000 Kenyan households lifted out of poverty)
- Women especially benefited
- Improved risk sharing *(spreading financial risks across family and community members)*

Why it works: When someone's crops fail, relatives can send money instantly via phone. Before M-Pesa, they'd have to physically travel with cash or use expensive services.

Mobile money shows technology can reduce barriers; requires complementary ecosystem

Digital Solutions to Payment Inefficiencies

Blockchain-Based

- Ripple/XRP *(cross-border payment company using blockchain technology)* for cross-border
- Stablecoins for remittances *(How it works: Buy stablecoins, send instantly, recipient converts locally—$1-2 total vs $6 traditional)*
- DeFi (Decentralized Finance—financial services on blockchain without traditional banks) payment rails (using blockchain networks as infrastructure for moving money)

Advantages:

- Bypass correspondent banking *(sending value directly via blockchain instead of routing through multiple intermediary banks)*
- 24/7 operation
- Lower intermediary costs

Traditional Innovation

- SWIFT gpi (Global Payments Innovation) improvements
- ISO 20022 (new global messaging standard for financial data) *(Structured data enables automation—like the difference between email and handwritten letters)*
- Linked instant payment systems

Comparison

- Blockchain: disruptive but immature
- Traditional: incremental but reliable
- Likely hybrid outcome

Competition between approaches benefits users; both have role to play

Competition and Regulation in Payments

Market Structure Issues

- Natural monopoly tendencies *(markets where one provider can serve everyone at lower cost than multiple competitors—common in payment infrastructure)*
- High barriers to entry
- Winner-take-most dynamics

Regulatory Responses

- Interchange caps (EU, US)
- Open banking mandates (regulations requiring banks to share customer data with authorized apps—e.g., EU's PSD2 (2018) forced banks to let apps like Revolut access your account data)
- Access to payment systems

Big Tech Entry

- Apple Pay, Google Pay
- Alipay, WeChat Pay
- Meta (stablecoin attempt—the Diem/Libra project, abandoned due to regulatory opposition in 2022) *(Why Big Tech is different: They already have your phone, your data, your habits—banks never had that relationship)*

Policy Concerns

- Data concentration
- Systemic risk (risk that one failure causes chain reaction—if a major payment system fails, the entire economy could freeze)
- Competitive fairness

Regulators balance innovation promotion against financial stability and competition

Key Takeaways

Main Conclusions

1. Payment systems are network goods
2. Two-sided markets require special analysis
3. Cross-border payments remain inefficient
4. Digital innovation offers solutions

Economic Framework

- Network effects and critical mass
- Two-sided market pricing
- Correspondent banking costs
- Financial inclusion economics

Core Insight

Payment system economics explains both why incumbents dominate and why digital disruption is difficult but potentially transformative.

Memorable anchor: India's UPI processes 10+ billion transactions/month with near-zero fees—proof that digital can scale.

Next lesson: Platform Economics and Token Economics

Key Terms (1/2)

RTGS (Real-Time Gross Settlement) Payment system settling transactions individually and immediately, eliminating settlement risk.

DNS (Deferred Net Settlement) System accumulating transactions and settling net positions at end of day, requiring less liquidity but more risk.

Interchange Fee Fee paid by merchant's bank to cardholder's bank for each card transaction—funds rewards programs.

Correspondent Banking Arrangement where banks hold accounts with each other to facilitate cross-border payments through intermediaries.

Two-Sided Market Platform connecting two user groups (e.g., cardholders and merchants) who provide value to each other.

Network Effects Value of payment network increases as more users and merchants participate—why dominant networks stay dominant.

Natural Monopoly Market where one provider can serve everyone at lower cost than multiple competitors—common in payment infrastructure.

Critical Mass Minimum number of users needed before a network becomes self-sustaining—typically around 16% adoption.

Issuer Bank that provides cards to consumers and extends credit (e.g., the bank that gave you your Visa card).

Acquirer Bank that processes card payments for merchants and deposits funds into their accounts.

Terms continued on next slide

Key Terms (2/2)

Settlement Risk Risk that one party delivers but the other defaults—eliminated by RTGS, present in deferred systems.

Liquidity Having cash available when needed—RTGS requires banks to hold more liquidity than netting systems.

Float Money in transit between accounts—delay benefits whoever holds it (earns interest) at the other's expense.

Remittances Money sent home by workers abroad—often to developing countries, with high fees (average 6%).

Netting Offsetting payments in opposite directions so only the net difference settles—reduces liquidity needs.

Price Elasticity How much demand changes when price changes. An elasticity of 2 means a 1% price increase causes a 2% drop in demand. Card users are less price-sensitive (low elasticity) than merchants (higher elasticity).

Bid-Ask Spread Difference between buy and sell prices for currency—wider spreads mean higher hidden costs.

Metcalfe's Law A network's value grows with the square of its users—10x users means 100x value, explaining network dominance.

Financial Inclusion Ensuring all people have access to useful and affordable financial services—1.4 billion adults lack bank accounts.

Mobile Money Financial services via mobile phone without a bank account—M-Pesa in Kenya pioneered this model.

Payment system economics involves trade-offs between efficiency, risk, and access

Further Reading

Academic Papers

- Rochet & Tirole (2003): "Platform Competition in Two-Sided Markets"
- Suri & Jack (2016): "The Long-Run Poverty and Gender Impacts of Mobile Money"
- Kahn & Roberds (2009): "Payments Settlement: Tiering in Private and Public Systems"

Policy Reports

- BIS – Bank for International Settlements (2020): "Enhancing Cross-border Payments"
- FSB – Financial Stability Board (2020): "Cross-border Payments Roadmap"
- World Bank Remittance Reports

All readings available on course platform