Econ 2203 | International Trade and Policy in Agriculture

Department of Development Economics

Foreign Exchange: Rates and Determination

How the rupee's price against the dollar shapes India's agricultural exports, food prices, and farmer incomes — and what economic theory tells us about why exchange rates move.

What is an Exchange Rate?

The nominal exchange rate is the price of one currency in terms of another.

$$e = \text{units of domestic currency per unit of foreign currency}$$

$$e_{INR/USD} = 83.5 \Rightarrow \text{1 USD costs } \ 83.5$$

- **Direct quote** (India convention): ₹ per USD — how many rupees to buy 1 dollar
- **Indirect quote**: USD per ₹ — how many dollars 1 rupee buys (= 1/83.5 = $0.012)

India 2024: The RBI reference rate hovered near ₹83–84/USD throughout 2024. A software exporter invoicing $1M receives ₹83.5 crore at spot. A food importer buying $1M of edible oil pays ₹83.5 crore. The same rate creates winners and losers simultaneously.

Spot vs Forward Rates

Feature	Spot Rate	Forward Rate
Settlement	Immediate (T+2)	Agreed today, settled at future date
Certainty	Current market price	Locked-in price for future delivery
India example	₹83.5/$	3-month forward: ₹84.2/$
Use	Immediate trade settlement	Hedging future currency exposure

Forward premium calculation:

$$\text{Forward Premium (p.a.)} = \frac{F - E}{E} \times \frac{12}{n} \times 100 = \frac{84.2 - 83.5}{83.5} \times 4 \times 100 = 3.35\%$$

Why forward rates matter for agri exporters: An Indian basmati exporter signing a 3-month USD contract today faces uncertainty — if INR appreciates by delivery, they receive fewer rupees. By selling USD forward at ₹84.2/$, they lock in their revenue. The forward premium (3.35%) reflects market expectations of INR depreciation.

Nominal vs Real Exchange Rate

The **nominal** rate tells us the currency price. The **real** rate tells us purchasing power competitiveness.

$$q = e \cdot \frac{P^*}{P}$$

where q = real exchange rate, e = nominal rate (₹/$), P^* = US price level, P = India price level.

Numerical example — Basmati Rice:

- India price: ₹5,010/quintal; US equivalent: $60/quintal; e = ₹83.5/$
- $q = 83.5 \times (60/5{,}010) = 83.5 \times 0.01197 = 0.999 \approx 1$
- If India inflation pushes price to ₹5,600 with same nominal e: $q = 83.5 \times (60/5{,}600) = 0.894$ → INR **real appreciation** → Indian rice less competitive even though nominal rate unchanged

Why the real rate is what matters for trade competitiveness: India's nominal exchange rate may be stable, but if domestic inflation outpaces foreign inflation, Indian goods become relatively expensive. Only a **real depreciation** — either a nominal depreciation or lower relative inflation — genuinely improves export competitiveness.

Real Effective Exchange Rate (REER): Trade-weighted average across all trading partners:

$$\text{REER} = \prod_i \left(e_i \cdot \frac{P_i^*}{P} \right)^{w_i}$$

Appreciation vs Depreciation

The key rule: If e rises (more ₹ per $) → INR **depreciates**. If e falls → INR **appreciates**.

INR Depreciation (e ↑, e.g. ₹75→₹85)

inr-depreciation-e-e.g.-7585

- **Cotton exporters:** same USD price = more ₹ revenue
- **Rice exporters (world's No.1):** Indian rice cheaper for foreign buyers
- **Spice/marine exporters:** competitive advantage
- **Edible oil importers:** same $ price = more ₹ cost → higher cooking oil prices

INR Appreciation (e ↓, e.g. ₹85→₹75)

inr-appreciation-e-e.g.-8575

- **Edible oil importers:** cheaper palm, soybean, sunflower oil
- **Pulses importers:** cheaper lentils from Canada/Australia
- **Fertiliser importers:** urea, DAP cheaper in ₹
- **Rice exporters:** Indian rice more expensive globally → volume loss

Demand for Foreign Exchange

Who demands USD (buys USD, sells ₹)?

- **Importers** (crude oil, edible oil, electronics, machinery)
- **Capital outflows** (Indian firms investing abroad, FPI selling)
- **Tourism abroad** (Indians travelling overseas)
- **Debt repayments** (external commercial borrowings in USD)
- **FPI outflows** (foreign portfolio investors exiting India)

Demand function: As e rises (INR depreciates), imports become expensive → quantity of USD demanded falls.

$$Q_D = 216 - 2e$$

where e is ₹ per USD and Q is billions of USD. Downward-sloping demand curve.

Agricultural angle: India's edible oil imports (~$14B/year) are the largest agricultural component of USD demand — palm oil from Indonesia/Malaysia, soybean oil from Argentina/Brazil, sunflower oil from Ukraine. A weaker rupee makes every litre more expensive.

Supply of Foreign Exchange

Who supplies USD (sells USD, buys ₹)?

- **Exporters** (IT services, rice, spices, cotton, pharmaceuticals) — earn USD, convert to ₹
- **FDI inflows** (foreign firms investing in India)
- **FPI inflows** (foreign portfolio investors buying Indian stocks/bonds)
- **Remittances** — largest single source at ~$100B/year (> FDI of $71B in FY2023)
- **External borrowings** (ECBs, NRI deposits)

Supply function: As e rises (INR weakens), Indian exports are cheaper globally → more exported → more USD earned and supplied.

$$Q_S = -116 + 2e$$

Upward-sloping supply curve. When e is high, each dollar of export revenue translates to more rupees — incentivising more exports.

Agricultural note: Rice ($10B+), spices ($4B+), cotton ($2B+), marine products ($8B+) are key agri supply sources of USD. A weak rupee boosts these exports.

Foreign Exchange Market Equilibrium

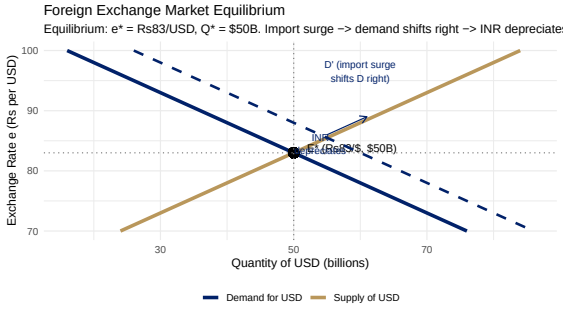

Figure 1: Foreign Exchange Market: Equilibrium Exchange Rate Determination Source: Author's illustration.

Solving for equilibrium: Set $Q_D = Q_S$:

$$216 - 2e = -116 + 2e \Rightarrow 332 = 4e \Rightarrow e^* = 83, \quad Q^* = 50$$

Factors Shifting Demand and Supply

Factor	Shift	Effect on e (₹/$)	INR
India inflation ↑	D shifts right	e ↑	Depreciates
India growth ↑ → imports ↑	D shifts right	e ↑	Depreciates
FDI/FPI outflows ↑	D shifts right	e ↑	Depreciates
Oil prices ↑	D shifts right	e ↑	Depreciates
Export earnings ↑	S shifts right	e ↓	Appreciates
FDI/FPI inflows ↑	S shifts right	e ↓	Appreciates
Remittances ↑	S shifts right	e ↓	Appreciates
RBI raises rates	S shifts right (capital inflows)	e ↓	Appreciates

India INR/USD Trend (2008–2024)

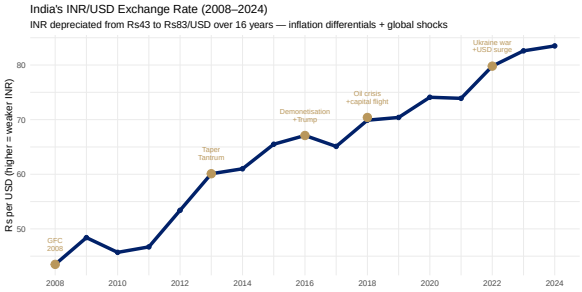

Figure 2: INR/USD Exchange Rate: Key Depreciation Episodes (2008–2024) Source: RBI, Database on Indian Economy (DBIE).

- **2008 GFC:** Global risk-off → capital flight from EMs. Rice/agri export demand fell; edible oil imports also dropped.
- **2013 Taper Tantrum:** Fed signalled rate hike → FPI outflows. Cotton, rice exporters saw ₹ revenue spike but volatile.
- **2018:** Iran sanctions + crude oil surge. India's $150B crude import bill inflated → INR hit ₹75.
- **2022 Ukraine:** Sunflower oil import disruption + USD surge → edible oil crisis in India.

Purchasing Power Parity: Absolute PPP

Foundation — Law of One Price: In competitive markets with free trade, identical goods sell at the same price internationally (once converted at the exchange rate).

Absolute PPP: If a representative basket costs ₹4,175 in India and $50 in the USA:

$$e_{PPP} = \frac{P_{India}}{P_{USA}} = \frac{4175}{50} = 83.5 \text{ per USD}$$

Absolute PPP says: the exchange rate should equal the ratio of price levels. If the actual rate differs from PPP, there is a real misalignment.

Big Mac Index 2024 — Reality Check:

Item	India	USA
Big Mac price	₹259	$5.69
Implied PPP	₹259/$5.69 = ∗∗ 45.5/∗∗	—
Actual rate	₹83.5/$	—
Verdict	INR **undervalued by ~45%** vs PPP	—

This does not mean INR is "wrong" — it reflects real structural differences (Balassa-Samuelson effect, see Slide 13).

Relative PPP

Relative PPP: Exchange rates change in proportion to inflation differentials.

$$\%\Delta e \approx \pi_{India} - \pi_{USA}$$

Numerical example:

If India's inflation $\pi_{India} = 5\%$ and USA's $\pi_{USA} = 2\%$:

$$\%\Delta e = 5\% - 2\% = +3\% \Rightarrow \text{INR depreciates 3\% per year}$$

Long-run empirical test for India:

- ₹45/USD (2000) → ₹83.5/USD (2024): **85.6% depreciation** over 24 years → **~3.5% per year**
- India avg CPI inflation (2000–2024): ~5.5%; US avg: ~2.2% → **differential ≈ 3.3%**
- ✓ **Broadly consistent with Relative PPP!**

Agricultural implication: Relative PPP predicts that India's ~3–4% annual INR depreciation roughly offsets the ~3% domestic cost inflation facing Indian farmers. This means Indian agri exports maintain their global price competitiveness in the long run — inflation at home is offset by depreciation in the exchange rate. Short-run deviations, however, create real competitive swings.

India: PPP-Implied vs Actual Rate

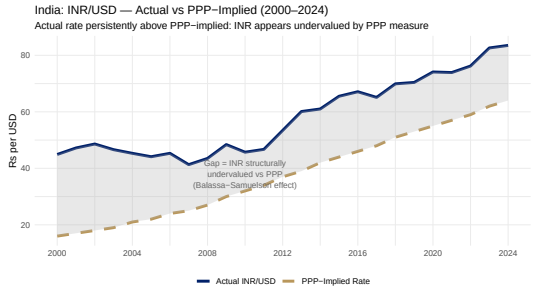

Figure 3: India: Actual Exchange Rate vs PPP-Implied Rate (INR/USD, 2000–2024) Source: RBI; World Bank, International Comparison Program (ICP).

Balassa-Samuelson Effect: Fast-growing economies (like India) have high productivity growth in tradables (IT, manufacturing) but not in non-tradables (haircuts, local food). This raises wages overall, making non-tradables expensive. PPP calculations using full CPI baskets therefore understate the "true" exchange rate for a developing economy — the gap between actual and PPP-implied is structurally expected, not a sign of manipulation.

Limitations of PPP

PPP is a powerful long-run benchmark but has important practical limitations:

1. **Non-tradable goods** — haircuts, education, land, local restaurants don't arbitrage across borders. Their prices differ permanently.
2. **Quality differences** — a "Big Mac" in Tokyo ≠ a Big Mac in Delhi in quality perception.
3. **Trade barriers** — tariffs, quotas, and transport costs prevent price equalisation even for tradables.
4. **Balassa-Samuelson effect** — richer/faster-growing countries systematically have currencies above PPP because productivity gains in tradables spill over to raise wages in non-tradables.
5. **Short-run irrelevance** — capital flows, sentiment, and central bank intervention dominate short-run exchange rates. PPP explains long-run trends, not day-to-day movements.

Agricultural implication: Agricultural commodities — rice, wheat, cotton, edible oils, spices — ARE tradable goods. PPP-based analysis is therefore more applicable to food prices than to services prices. When the IMF/World Bank assess food affordability across countries, they use PPP-adjusted incomes. India's apparent INR undervaluation by PPP helps explain why Indian agricultural exports are consistently price-competitive globally.

Interest Rate Parity: Uncovered IRP

Setup: An Indian investor has ₹1 crore to invest for 1 year. Two options:

1. **INR bond** earning $i_{India} = 7\%$ → get ₹1.07 crore in 1 year
2. **USD bond** earning $i_{USA} = 5\%$, but must convert ₹ to $ now and $ back to ₹ later

Uncovered Interest Rate Parity (UIP): In equilibrium, expected returns must be equal:

$$i_{India} = i_{USA} + \frac{E^e - E}{E}$$

where E^e = expected future exchange rate (uncertain — hence "uncovered").

Rearranged:

$$\frac{E^e - E}{E} = i_{India} - i_{USA} = 7\% - 5\% = 2\%$$

→ Market expects INR to **depreciate 2% per year** to equalise returns.

Interpretation: India's higher interest rates do NOT simply attract unlimited capital inflows — because investors price in the expected currency depreciation. The interest rate advantage is exactly offset (in equilibrium) by the expected loss from holding a depreciating currency. This is why India cannot run 8% rates indefinitely without currency pressure.

UIP Diagram

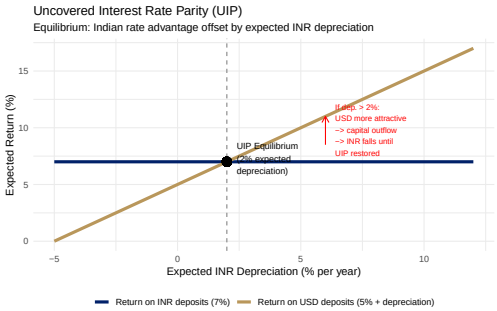

Figure 4: Uncovered Interest Rate Parity: Expected Return Equalization Source: Author's illustration.

Covered vs Uncovered IRP

Covered Interest Rate Parity (CIP): Uses the *forward* exchange rate — no uncertainty.

$$i_{India} = i_{USA} + \frac{F - E}{E}$$

where F = forward exchange rate (agreed today, settled at future date — no currency risk).

Uncovered Interest Rate Parity (UIP): Uses the *expected future spot* rate — uncertain.

$$i_{India} = i_{USA} + \frac{E^e - E}{E}$$

Empirical verdict:

- **CIP** holds almost perfectly in practice — arbitrage desks enforce it millisecond-to-millisecond.
- **UIP** weaker empirically — exchange rate risk premium and investor irrationality cause deviations.

Numerical CIP check (India, 2024):

- Spot E = ₹83.5/$; 3-month forward F = ₹84.2/$
- Forward premium = $(84.2 - 83.5)/83.5 \times 4 \times 100 = 3.35\%$ p.a.
- Interest differential: $i_{India} = 6.5\%, i_{USA} = 5.3\% \rightarrow \Delta i = 1.2\%$
- Gap (3.35% vs 1.2%) is explained by **country risk premium** on Indian sovereign debt.

Agri exporter hedging via CIP: A rice exporter expecting $5Min6monthssellsUSDforwardat\ 84.2/$. CIP guarantees the forward rate is fairly priced relative to the interest differential — no "free money" from hedging, but the exporter eliminates revenue uncertainty. The forward premium (3.35%) is the cost of certainty.

RBI Intervention in the Forex Market

How RBI intervenes:

- **Preventing excessive depreciation:** RBI *sells* USD from reserves → increases USD supply in market → reduces e (strengthens INR)
- **Preventing excessive appreciation:** RBI *buys* USD → reduces USD supply → increases e (weakens INR)

Sterilisation mechanism:

When RBI buys USD (injects ₹ into economy): 1. Buy USD → ₹ liquidity increases (inflationary) 2. Simultaneously *sell* government securities (G-secs) → absorbs ₹ back 3. Net effect: money supply *neutral*, but forex reserves increase

India's forex reserve trajectory:

Year	Reserves	Import cover
1991	$1.2B	2 weeks (**crisis**)
2004	$113B	~12 months
2024	$304B	~8 months

Sterilisation and agriculture:

When RBI sterilises USD purchases: - G-sec yields are kept from falling - Domestic interest rates remain higher - This keeps credit costs for agri sector elevated

RBI's twin mandate — currency stability + price stability — creates a constant tension in agri credit markets.

India is NOT classified as a currency manipulator by the US Treasury — interventions are two-sided and RBI has intervened in both

Determinants Summary Table

Factor	Channel	Effect on e (₹/$)	INR Direction
India inflation ↑	PPP/competitiveness	e ↑	Depreciates
India growth ↑ → imports ↑	Current account	e ↑	Depreciates
FDI/FPI outflows ↑	Capital account	e ↑	Depreciates
Oil prices ↑ (India imports 85%)	Import demand	e ↑	Depreciates
US Fed raises rates	Carry trade reversal	e ↑	Depreciates
Remittances ↑	Capital inflows	e ↓	Appreciates
RBI raises repo rate	Capital inflows	e ↓	Appreciates
Export boom (rice, IT)	Current account	e ↓	Appreciates

Implications for Agricultural Trade

Depreciation (e ↑: ₹75→₹85) — Winners (Exporters):

- Rice (~$10B/yr): world's No.1 exporter; ~10.7% cheaper for importers
- Spices (~$4B/yr): highly price-elastic globally
- Marine products (~$8B/yr): shrimp, fish more competitive

Appreciation (e ↓: ₹85→₹75) — Winners (Importers):

- Edible oils ($14B+/yr): cheaper cooking oil for consumers
- Pulses ($3B+/yr): cheaper lentils, chickpeas

Exchange Rate: The Policy Tension

RBI's dilemma for agricultural trade:

- Defending INR → helps consumers (lower food inflation) but hurts agri exporters
- Allowing depreciation → helps exporters but risks food inflation spiral

India's response: simultaneously subsidise fertilisers (mitigate input cost channel) **and** impose rice export bans (protect domestic supply) — policies that interact with the exchange rate in complex ways.

Key Takeaways

Six core concepts from Lecture 11:

1. **Exchange rate notation:** $e = \ /USD$; higher e = weaker INR (depreciation); lower e = stronger INR (appreciation)
2. **Market equilibrium:** $Q_D(e) = Q_S(e)$ determines e^*; shifts from trade and capital flows move equilibrium. Solving: $216 - 2e = -116 + 2e \Rightarrow e^* = 83$
3. **Real exchange rate** $q = e \cdot P^*/P$: only real depreciation — not just nominal — genuinely improves export competitiveness. REER is the trade-weighted measure RBI monitors.
4. **Absolute PPP:** $e_{PPP} = P/P^*$; India's actual rate » PPP (Balassa-Samuelson); **Relative PPP:** $\Delta e \approx \pi - \pi^*$ — ~3–4% annual INR depreciation predicted and observed over 2000–2024.
5. **Interest Rate Parity (UIP):** $i_{India} - i_{USA} = (E^e - E)/E$; India's higher rates are offset by expected depreciation — no free lunch from the interest differential.
6. **Agriculture:** depreciation boosts rice/cotton/spice exports; raises edible oil/fertiliser import costs — a constant policy tension that explains India's oscillation between export bans and import duty waivers.

Next Lecture: Exchange Rate Systems and Open Economy Macroeconomics

Lecture 12 (July 11, 2026):

Forex Market — Exchange Rate Systems and Open Economy Macro

We will cover:

- Fixed vs floating vs managed exchange rate systems
- The Impossible Trinity (Mundell trilemma)
- Mundell-Fleming model: IS-LM-BP
  - Fiscal and monetary policy effectiveness under different regimes
- RBI's managed float in practice
- India's forex reserves: from crisis to abundance
- Forward market and currency hedging
- Exchange rate pass-through to agricultural prices

Bridge from today:

Today we learned *how* the rupee rate is determined by supply/demand, PPP, and interest rate parity.

Next lecture we study:

- What *system* India operates under
- How government **policy** affects the exchange rate
- How open-economy **macroeconomics** links monetary policy, fiscal policy, and the exchange rate

Reading: Salvatore Ch 14-15; Appleyard Ch 20-21

Additional Resources

Further Reading

- *International Economics* — Salvatore (Ch. 15-16)
- *International Economics* — Appleyard & Field (Ch. 15-16)
- RBI/DGCI&S/APEDA databases for latest data

Key Data Sources

- DGCI&S: India's merchandise trade
- RBI: Balance of payments data
- APEDA: Agricultural export statistics
- WTO: Tariff and trade databases