

International Finance

Purchasing Power Parity and Real Exchange Rates

Main issues

- Does exchange rate risk exist?
- Purchasing power parity: absolute and relative
- Empirical evidence across horizons
- The real exchange rate and why PPP failure matters for firms

The question

Is there exchange rate risk?

Most likely – but not necessarily.

If all prices adjust immediately and fully to exchange rate changes, then nominal FX movements have no real effect.

This is what **Purchasing Power Parity** claims.

The thought experiment

- USD/CAD = 1.00. An iPhone costs 650 USD in the US and 650 CAD in Canada.
- Exchange rate moves to 1.10 (CAD depreciates by 10%)
- If the CAD price drops to $650/1.10 = 590.91$, buying in either country still costs 650 USD
- This is PPP in action — prices adjust to offset the exchange rate move

Does this actually happen?

Apple and Brexit: a natural experiment

June 2016: GBP depreciates $\$ \rightarrow$ \$15% after Brexit referendum.

Apple raises UK prices weeks later:

	GBP Price	USD/GBP	Implied USD Price
May 2016 (pre-Brexit)	£499	1.45	\$724
Sep 2016 (post-Brexit)	£549	1.33	\$730

Some pass-through happened — but it took weeks, was incomplete, and was a discrete jump.

Not the smooth continuous adjustment PPP assumes.

The real exchange rate

Define the **real exchange rate**:

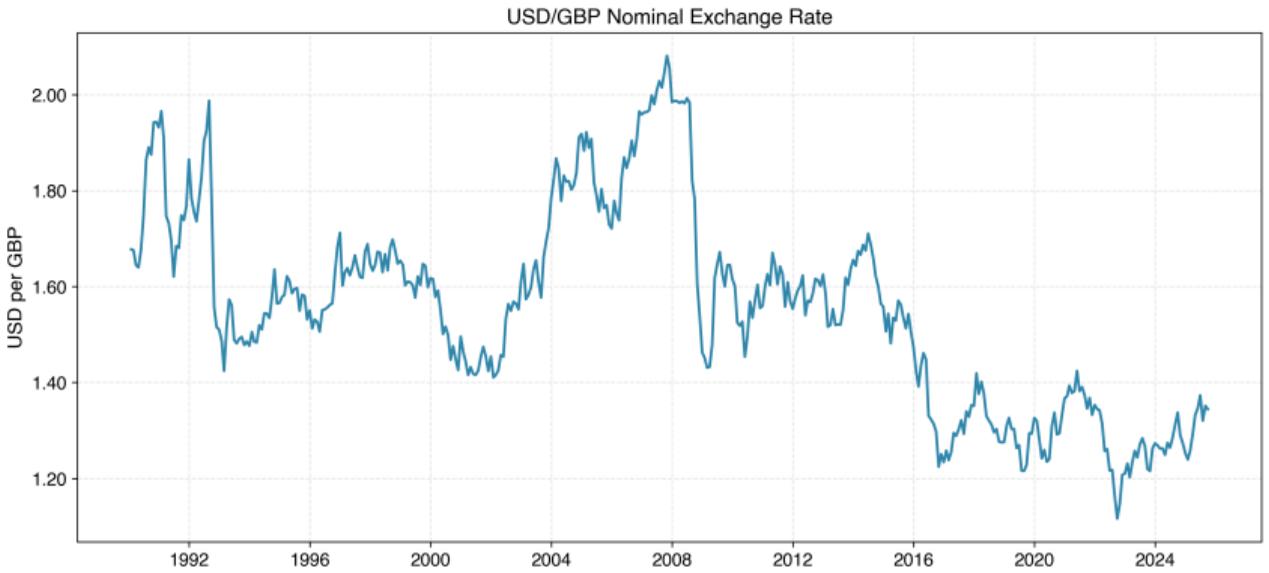
$$e_t = S_t \cdot \frac{P_t^*}{P_t}$$

where S_t is the nominal rate (HC/FC), P_t is the HC price level, P_t^* is the FC price level.

- If PPP holds: $e_t = 1$ (or constant)
- If e_t moves: there is **real exchange rate risk**

Preview: e_t is *not* constant. Not even close.

USD/GBP nominal exchange rate



Absolute PPP: definition

The exchange rate equals the ratio of price levels:

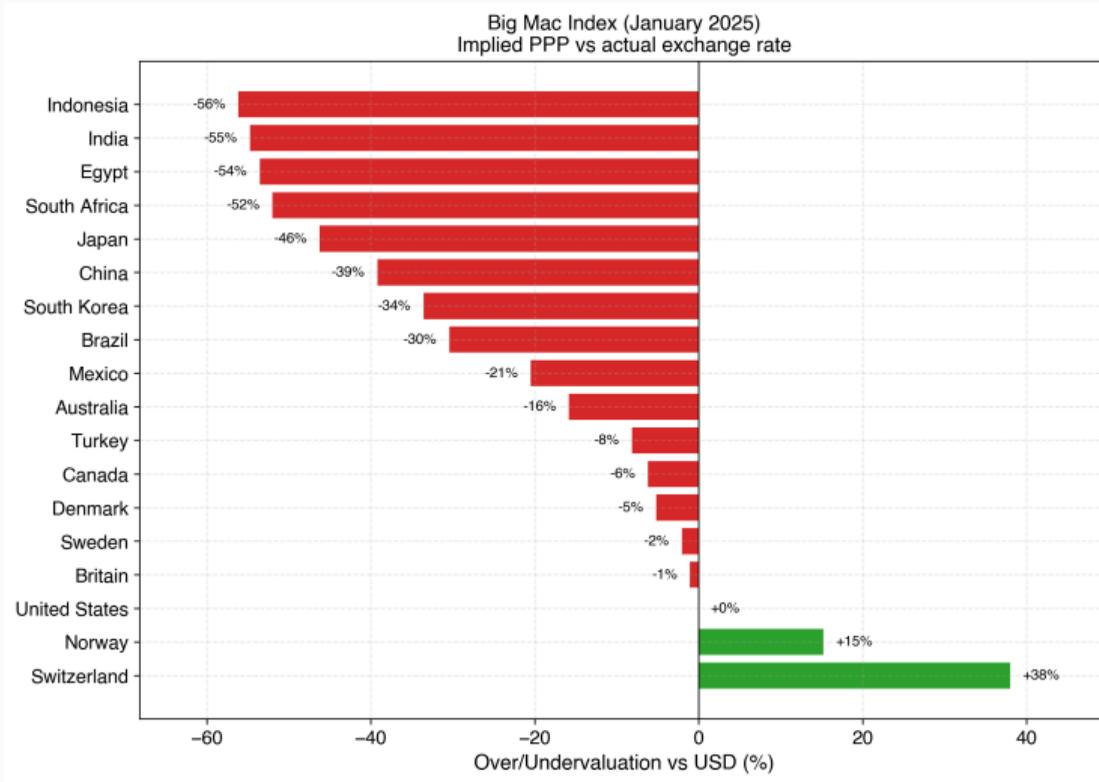
$$S_t = \frac{P_t}{P_t^*}$$

Rationale: If the equality does not hold, one could exploit “real” arbitrage on physical goods. Prices should be the same once converted to a common currency.

Example: If a good costs \$0.50 in the US and NOK 1.50 in Norway:

$$\text{USD/NOK} = \frac{0.50}{1.50} = \frac{1}{3}$$

The Big Mac Index



Why absolute PPP fails

- Many goods are **non-traded**: high transport costs (cement, bricks), services (haircuts, healthcare)
- Even for traded goods: transport costs, tariffs, trade barriers create **bands** around PPP
- Only considers goods and services, not **capital flows**
- **Balassa-Samuelson effect** creates systematic deviations (next slide)

Conclusion: Absolute PPP — $e_t = 1$ always — is too strong. We need to relax it.

Balassa-Samuelson effect (1964)

1. Productivity in **traded goods** is higher in developed countries than emerging economies
2. Productivity in **non-traded services** is similar everywhere (haircuts, taxis)
3. But **wages equalize within a country** across sectors — so non-traded goods are expensive in rich countries

Example: A haircut costs \$40 in Oslo and \$15 in São Paulo — but the barbers are equally skilled.

Implication: Price levels are systematically higher in richer countries. Absolute PPP is biased.

Relative PPP: definition

Exchange rate **changes** should be proportional to **relative inflation**:

$$S_1 = \frac{P_1/P_0}{P_1^*/P_0^*} \cdot S_0$$

Log-differenced version:

$$\Delta s_t \approx \pi_t - \pi_t^*$$

This relaxes the level condition — only requires **changes** to offset.

Relative PPP: rationale and prediction

Rationale:

- Higher inflation at home → home currency depreciates
- Depreciation compensates foreign buyers for higher domestic prices

Prediction:

- If domestic prices rise 50% and foreign prices are flat, the domestic currency should depreciate 50%

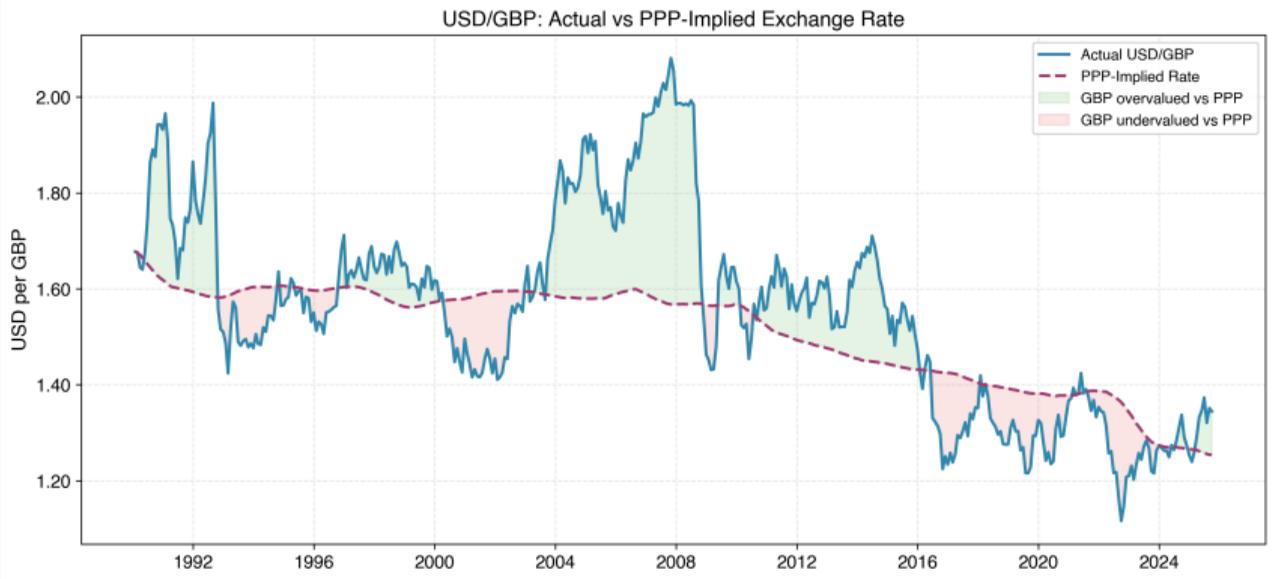
What it does NOT require: That price levels are equalized across countries (unlike absolute PPP)

Why relative PPP also fails

- Does not account for **structural changes** (wars, regime shifts, financial crises)
- **Balassa-Samuelson** applies here too: if one country is growing faster, its non-traded prices rise faster, creating a secular trend
- Works better at **very long horizons** (decades) but poorly at business-cycle frequencies

How badly does it fail? Let's look at the data.

Actual vs. PPP-implied exchange rate



Data: 1990–2025. PPP-implied rate uses cumulative US vs UK inflation from base period.

PPP regression test: setup

Regression:

$$\ln \frac{S_{t+h}}{S_t} = a + b \left[\pi_{t,t+h}^{US} - \pi_{t,t+h}^{UK} \right] + u_{t+h}$$

PPP null hypothesis: $a = 0$ and $b = 1$

- Test at multiple horizons: $h \in \{1, 3, 5\}$ years
- Forward-looking inflation: $\pi_{t,t+h} = \ln(P_{t+h}/P_t)$
- Newey-West HAC standard errors (overlapping observations)

PPP regression results

$$\text{PPP Regression: } \ln(S_{t+h}/S_t) = a + b[\pi_{t,t+h} - \pi_{t,t+h}^*] + u$$

Newey-West HAC standard errors

USD/GBP

USD/EUR

	1Y	3Y	5Y	1Y	3Y	5Y
Intercept a	-0.016	-0.021	0.006	0.004	-0.029	-0.105
t-stat (a=0)	-1.13	-0.56	0.11	0.28	-1.24	-1.87
Slope b	-0.853	0.452	1.478	-1.333	0.890	2.800
t-stat (b=1)	-3.30	-0.83	0.50	-2.43	-0.07	0.63
R ² (%)	1.6	0.8	8.9	2.0	1.2	9.4
N	417	393	369	417	393	369
HAC lags	11	35	59	11	35	59

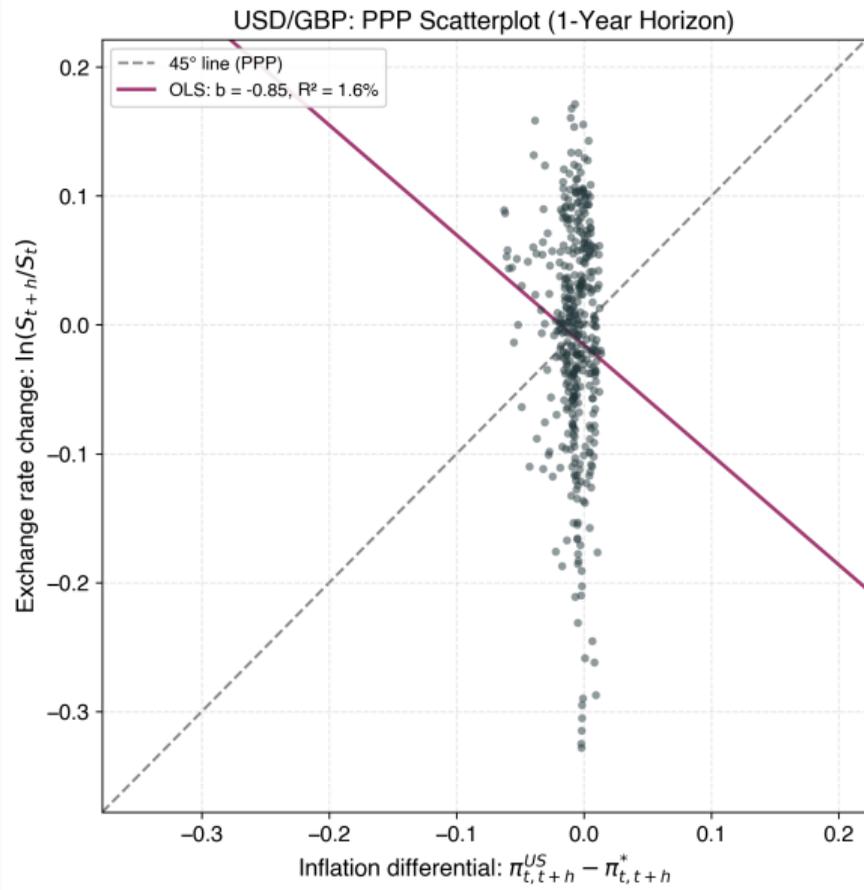
Interpreting the results

- Short horizon (1Y): $R^2 \approx 0$, slope far from 1 \rightarrow PPP has **no predictive power**
- Medium horizon (3Y): R^2 improves, slope moves toward 1 \rightarrow slow convergence
- Long horizon (5Y): R^2 rises further \rightarrow PPP gains explanatory power but remains noisy

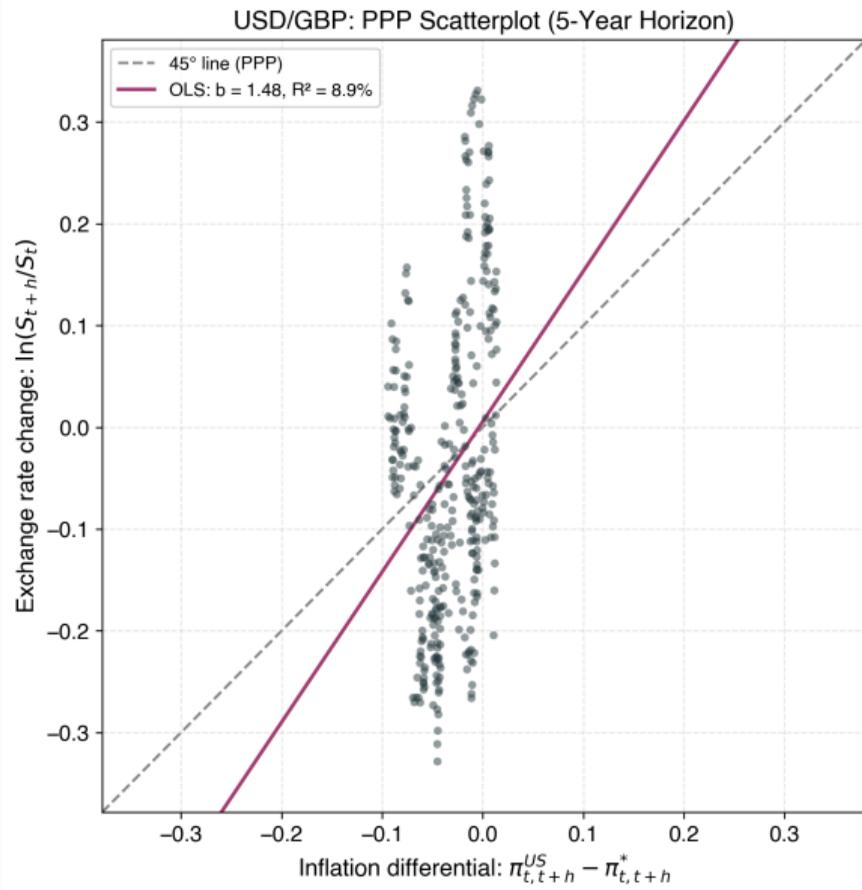
Same pattern for USD/EUR — this is not a GBP-specific result.

The PPP puzzle (Rogoff 1996): Deviations have half-life of 3–5 years. Too slow for nominal rigidities alone. Too fast for purely real shocks.

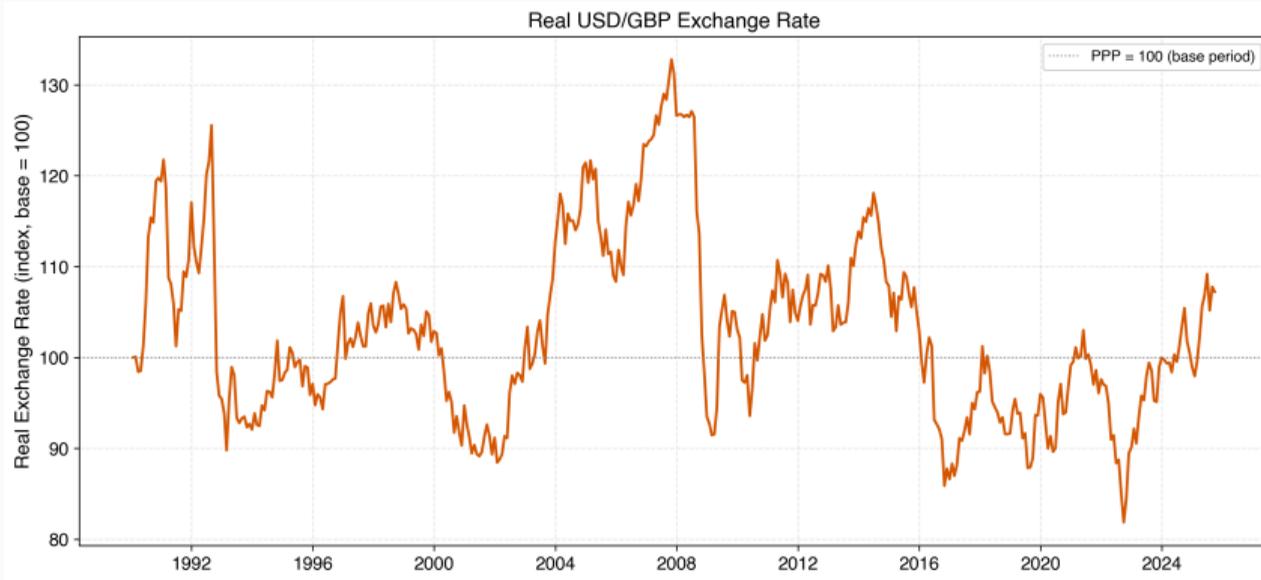
PPP scatterplot: 1-year horizon



PPP scatterplot: 5-year horizon



Real exchange rate over time



$$\text{Real USD/GBP} = S_t \cdot P_t^{UK} / P_t^{US}, \text{ indexed to 100 at start of sample.}$$

What the real exchange rate tells us

- Swings of $\pm 30\%$ lasting **years** — not noise
- Mean-reverting over decades but **not** at business-cycle frequencies
- Each swing represents a period where goods are genuinely cheaper or more expensive across countries

When the real rate rises: Foreign goods become expensive relative to domestic. Domestic exporters gain competitiveness.

When the real rate falls: The reverse. Domestic firms face margin compression from foreign competition.

Why this matters for the firm

PPP failure means nominal FX changes have **real effects**:

- Revenue in FC may **not** be offset by cost changes
- Competitive position shifts with the real exchange rate
 - A German automaker vs. a Japanese rival: EUR/JPY matters *in real terms*
- Margin compression, volume changes, supply chain costs

This is the bridge from Layer 1 to Layer 3:

- Real FX risk → operating exposure (Lecture 4)
- Real FX risk → affects expected CFs in cross-border valuation (Lectures 7–8)

Key takeaways

- **Absolute PPP** fails: non-traded goods, transport costs, Balassa-Samuelson
- **Relative PPP** works only at very long horizons (decades, not years)
- **Real exchange rate risk** is persistent and economically large ($\pm 30\%$)
- **For the firm:** FX exposure is *real*, not just nominal — this is why hedging, financing, and investment decisions are hard

CF vs. DR: PPP failure is primarily a **cash flow effect** — it changes real revenues, margins, and competitive position.

Where this fits in the course

- **PPP failure** motivates the entire corporate block:
 - If PPP held, why hedge? → Risk management (Lectures 4–5)
 - If PPP held, does borrowing currency matter? → Financing (Lecture 6)
 - If PPP held, are foreign CFs risky? → Investment (Lectures 7–9)
- **Next lecture:** CIP, UIP, and the forward rate — from goods-market parity to financial-market parity

Other exchange rate models exist (monetary approach, Dornbusch overshooting, portfolio balance) — they all perform poorly at short horizons. We focus on what matters for the firm.