

International Economics: Lecture 20
Exchange rates in the Long run: PPP

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The Lecture Motivation

Did Armenian goods become relatively cheaper? Would Russians have increased their spending on Armenian goods, or Armenian have decreased their spending on Russian goods?

The cost of living generally rises, but its increase isn't equiproportional in different parts of the world.

2000-16. Price Increase
 Armenia, 1.9 times
 Russia, 5.2 times
 USA, 1.4 times

	2000	2016
AMD/RUB	19.2	7.2
AMD/USD	540	480

Dram appreciated 3 times against rouble, & 1.1 times against dollar.

Data: UNECE

A standardized basket of goods, which cost 100K AMD in 2000 rose in price to 190K AMD in 2016 in Armenia.

Over the same period, a basket of goods rose in price from 5.2K RUB to 27K RUB.

$$100K \text{ AMD} = 19.2 \times 5.2K \text{ RUB} \quad (\text{in } 2000)$$

$$190K \text{ AMD} \quad \textcircled{7} \quad \times 27K \text{ RUB} \quad (\text{in } 2016)$$

actual rate was 7.2

So, a basket, which cost 27K RUB in 2016, would had cost 196K AMD, mere 3.4% deviation.

K – thousand

Consumer price index, measures the price change of a standardized basket of consumer goods.

The Lecture Motivation

Although, Russian prices rose about 2.8 times more, than Armenian prices, but over the same period dram appreciated against rouble about 3 times.

2000-16, price increase
 Armenia, 1.9 times
 Russia, 5.2 times
 USA, 1.4 times

Therefore, the cost of the baskets in each country expressed in the same currency increased by about the same amount.

The relative *purchasing power* of each currency has remained about the same.

	2000	2016
AMD/RUB	19.2	7.2
AMD/USD	540	480

Is this a coincidence?

No, *as in the long run, prices and exchange rates adjust to each other.*

Dram appreciated
 3 times against rouble,
 & 1.1 times against
 dollar.

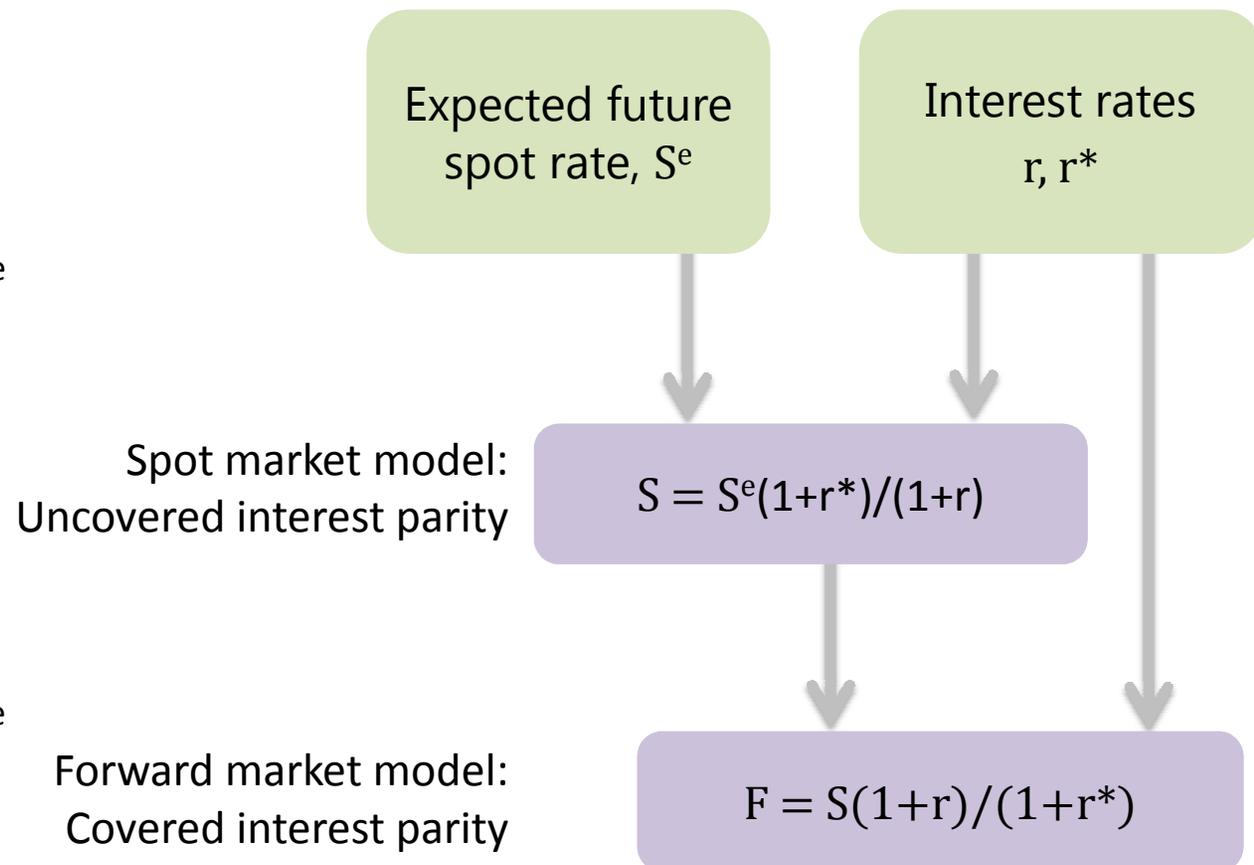
And this hypothesis is a key building block in the theory of exchange rate determination.

Interest parities, spot rate, forward rate

Uncovered interest parity provides a theory of spot exchange rate determination, given the knowledge of the:

- 1) Expected future exchange rate,
- 2) Home interest rate, and
- 3) Foreign interest rate.

In this lecture we look at the long run to see how the expected future exchange rate is determined.



The law of one price

Due to ***goods market arbitrage*** goods prices in different countries expressed in a common currency must tend to be equalized.

*Applied to a single good, this idea is referred to as the LOOP.
..... basket of goods, PPP.*

This 'law' should hold, as otherwise buyers would rush to buy at a cheap location (forcing prices up there) and would avoid from the expensive location (forcing priced down there).

Trade frictions (transport cost, tariffs) will hinder the process, but will not stop it.

Therefore, LOOP holds in the idealized world of

- no market frictions, and of
- perfect competition and complete price flexibility

The law of one price

LOOP - identical goods sold in different locations must sell for the same price when expressed in a common currency.

Suppose a car  is priced at 400K RUB in Moscow.

AMD/RUB exchange rate is 8.5.

So, if the LOOP holds, the same car should sell in Yerevan for 3.4M AMD. Otherwise, a profitable arbitrage opportunity will arise, which will equalize the prices.

$$\text{Relative price of car in Russia versus Armenia (q)} = \frac{S_{\text{AMD/RUB}} \times P_{\text{RUS}}}{P_{\text{ARM}}}$$

If $q=2$, then two units of Armenian car are needed to purchase one unit of Russian car.

If $q>1$, then Russian cars are costlier. If $q<1$, then Russian cars are cheaper.

Only when $q=1$, then the price is the same in both locations, there is no arbitrage opportunity, and LOOP holds

The law of one price

$$\text{Relative price of car in Russia versus Armenia (q)} = \frac{S_{\text{AMD/RUB}} \times P_{\text{RUS.car}}}{P_{\text{ARM.car}}}$$

Only when $q=1$, then the price is the same in both locations, there is no arbitrage opportunity, and LOOP holds

LOOP

$$S_{\text{AMD/RUB}} = \frac{P_{\text{ARM.car}}}{P_{\text{RUS.car}}}$$

Exchange rate

Ratio of cars price

Purchasing power parity

PPP is the macroeconomic counterpart to the microeconomic 'law' of one price (LOOP).

LOOP relates exchange rate to the relative price of an individual good.

PPP relates exchange rate to the relative price of a basket of goods.

Price level (P) is a weighted average of the prices of all goods in a consumer basket, using the same goods and weights in both locations.

P_{ARM} - price level in Armenia

P_{RUS} - price level in Russia

If the law of one price holds for each good in the basket, it will also hold for the price of the basket as a whole.

Purchasing power parity

Relative price of a basket in
Russia versus Armenia (q)

=

$$\frac{S_{\text{AMD/RUB}} \times P_{\text{RUS}}}{P_{\text{ARM}}}$$

Russian price of the basket
expressed in dram

Armenian price of the basket
expressed in dram

PPP holds when relative price of the basket is equal to 1.
This statement is called **absolute PPP**.

PPP

$$S_{\text{AMD/RUB}} = \frac{P_{\text{ARM}}}{P_{\text{RUS}}}$$

Exchange
rate

Ratio of
price levels

The real exchange rate

Relative price of a basket in
Russia versus Armenia (q)

=

$$\frac{S_{\text{AMD/RUB}} \times P_{\text{RUS}}}{P_{\text{ARM}}}$$

Russian price of the basket
expressed in dram

Armenian price of the basket
expressed in dram

The relative price of the baskets is so important, that it has a special name, ***real exchange rate***. It tells how many Armenian baskets of goods can be exchanged for one Russian basket.

- If the real exchange rate rises (more Armenian goods are needed in exchange for Russian goods), we say Armenia has experienced a **real depreciation**.
- If the real exchange rate falls (fewer Armenian goods are needed in exchange for Russian goods), we say Armenia has experienced a **real appreciation**.

Absolute PPP and the real exchange rate

$$\text{Relative price of a basket in Russia versus Armenia (q)} = \frac{S_{\text{AMD/RUB}} \times P_{\text{RUS}}}{P_{\text{ARM}}}$$

Absolute PPP states that the real exchange rate is equal to 1

- If the real exchange rate is below 1 by x%, then Russian goods x% cheaper than Armenian goods. The dram is said to be strong, the rouble is **undervalued** by x%.
- If the real exchange rate is above 1 by x%, then Russian goods are x% more expensive than Armenian goods. Dram is weak, the rouble is overvalued by x%.

For example, if a Russian basket costs 100,000 drams, and an Armenian basket costs only 80,000 drams, then $q_{\text{RUS/ARM}} = 1.25$. The rouble is strong, and is 25% overvalued against the dram.

Big Mac Index

PPP predicts that in the long-run exchange rates should move towards the rate that would equalize the prices of an identical basket of goods and services in any two countries.



Big Mac price in January 2017

USA - \$5.06

Russia - \$2.15 (130 Roubles; Actual spot: 60.44; Implied exchange rate: 25.69)
thus, the Rouble was undervalued by 58%.

Highest prices: Switzerland: \$6.35, overvalued by 26%

Norway: \$5.67, overvalues by 12%

Lowest prices: Egypt: \$1.46, undervalued by 71%

Ukraine: \$1.54, undervalued by 70%.

PPP is the heart and soul of *International Macroeconomics*

Under the skin of any international economist lies a deep-seated belief in some variant of the PPP theory of the exchange rate.

Dornbusch R., Krugman P.
Flexible Exchange Rates in the Short Run. *Brookings Papers on
Economic Activity* 3, 537-576 (1976)

Absolute PPP

Relative price of a basket in
Russia versus Armenia (q)

$$= \frac{S_{\text{AMD/RUB}} \times P_{\text{RUS}}}{P_{\text{ARM}}}$$

Absolute PPP

$$S_{\text{AMD/RUB}} = \frac{P_{\text{ARM}}}{P_{\text{RUS}}}$$

Exchange
rate

Ratio of
price levels

Absolute PPP implies:

Exchange rate = Relative price levels of the 2 countries

For example, if the same basket of goods costs

- 80K drams in Armenia and
- 10K roubles in Russia, then absolute PPP predicts
- an exchange rate of 80K/10K = 8 drams per rouble.

Absolute PPP

prices, and nominal exchange rate

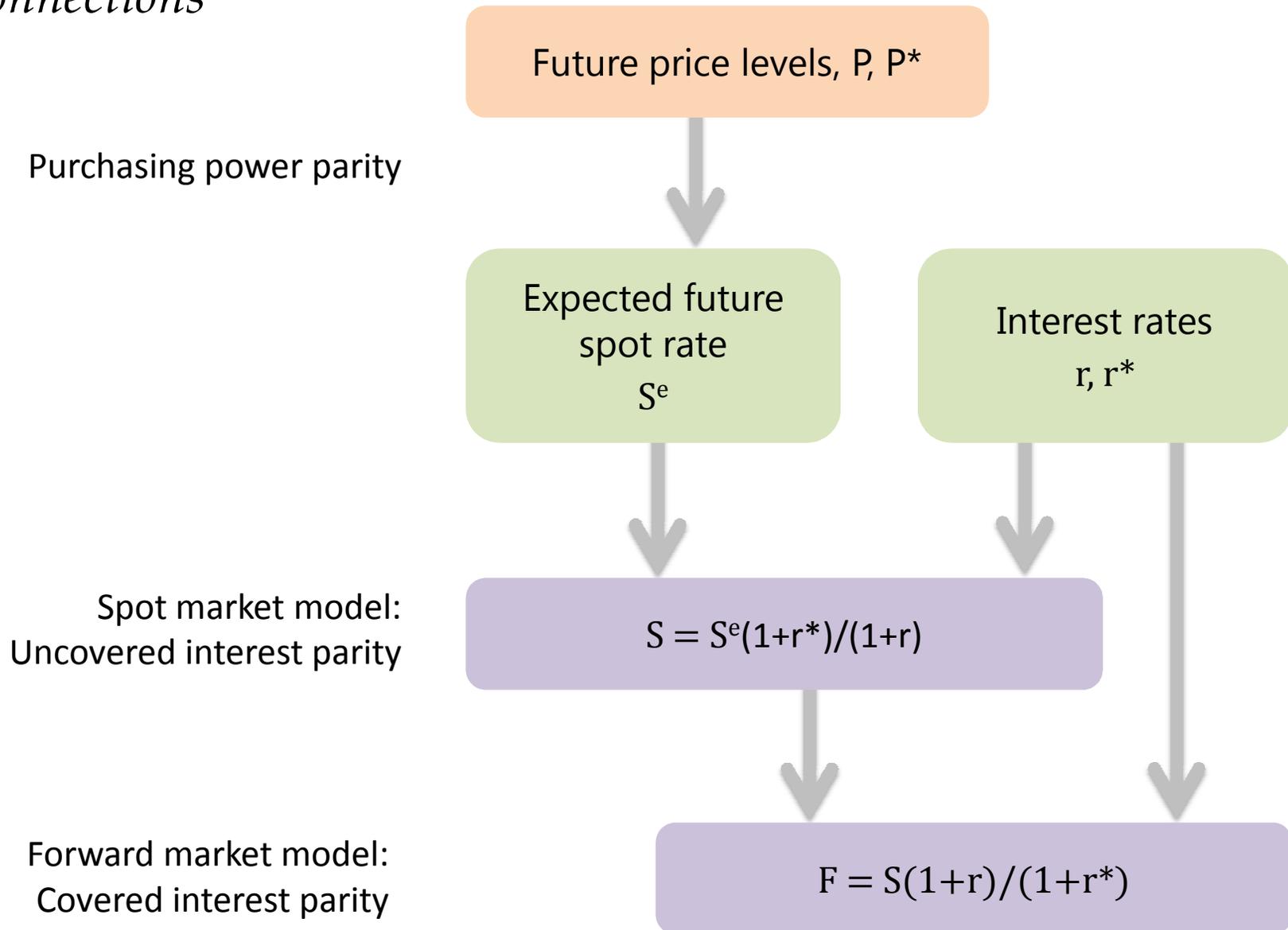
Thus, if we know the price levels in different locations, we can use PPP to determine an implied exchange rate,

subject to the assumptions about

- frictionless trade,*
- flexible prices,*
- free competition, and*
- identical goods.*

Moreover, we can use PPP to forecast the expected future exchange rate implied by forecasted future price levels.

Connections



Relative PPP

inflation, and exchange rate depreciation

Relative PPP

$$\% \Delta S_{\text{AMD/RUB}} = \pi_{\text{ARM}} - \pi_{\text{RUS}}$$

Exchange rate
depreciation

Inflation
differential

Relative PPP implies:

Exchange rate change = inflation differential

For example, if Russian inflation is 7%, and Armenian inflation is 2%, then we expect a 5% depreciation of the rouble against dram.

Actually, during the 2000-2016, Russian prices rose 176% more, than Armenian prices, and the rouble depreciated 167% against dram.

Relative PPP

inflation, and exchange rate depreciation

Relative PPP

$$\% \Delta S_{\text{AMD/RUB}} = \pi_{\text{ARM}} - \pi_{\text{RUS}}$$

Exchange rate
depreciation

Inflation
differential

Absolute PPP: $S = P/P^*$

The rate of change of the exchange rate is the exchange rate depreciation

Depreciation: $(S_1 - S_0)/S_0$

The rate of change of the relative prices is APPROXIMATELY equal to the

- the rate of change of numerator MINUS
- the rate of change of denominator.

Inflation differential: $(P_1 - P_0)/P_0 - (P_1^* - P_0^*)/P_0^*$

Absolute PPP relates

prices to nominal exchange rate

Absolute PPP

$$S_{\text{AMD/RUB}} = \frac{P_{\text{ARM}}}{P_{\text{RUS}}}$$

Exchange
rate

Ratio of
price levels

Relative PPP relates

inflation to exchange rate depreciation

Relative PPP

$$\% \Delta S_{\text{AMD/RUB}} = \pi_{\text{ARM}} - \pi_{\text{RUS}}$$

Exchange rate
depreciation

Inflation
differential

PPP GDP

PPP GDP is GDP converted to international dollars using PPP rates.

An international dollar has the same purchasing power over GDP as the U.S. dollar has in the U.S.

	GDP per capita, PPP (current international \$), 2015			GDP (current US\$), 2015	
		Implied PPP rate		Exchange rate	
Armenia	8,419	198.1	2.4	3,489	477.9
Russia	24,451	22.6	2.7	9,093	60.9
U.S.	56,116	1	1	56,116	1

Nominal / Implied

→ PPP implied by Big Mac index: 18.58

Source: WB WDI database

Factors behind PPP deviations

1. Transaction costs (transportation costs, tariffs, taxes).
2. Nontraded goods (real estate).
3. Different labor costs.
4. Imperfect competition (market power).
5. Price stickiness in the short run.

Despite all these problems, PPP is a useful approach as a long-run theory of exchange rate determination.



Big Mac price in January 2017

USA - \$5.06

Russia - \$2.15

(130 roubles;

Actual spot: 60.44;

Implied exchange rate: 25.69)

thus, the rouble was undervalued by 58%.

Thank you and take care,

but remember

Education is the path from
arrogant ignorance to
miserable uncertainty.

Mark Twain