Lesson X: Overview

1. FX market efficiency
2. The art of foreign exchange rate forecasting

FX market efficiency

Terminology I

K markets are said to be *efficient* whenever their *prices* ***fully reflect*** all the ***available information***

- What is "**available information**"?
- What does "**fully reflect**" mean?

Terminology II

What is "available information"?

"Efficiency" can take on different meanings, depending on what is included in the (broad) concept of "available information"

- **Weak-form efficiency**: the information set only includes historical prices/returns on a given asset
- **Semi strong-form efficiency**: the available information includes all publicly known data
- **Strong-form efficiency**: prices are formed based both on public and private (insider) information

Terminology III

What does "fully reflect mean"?

This term basically implies that market efficiency is an **equilibrium** situation, such that prices completely incorporate all the available information.

Major implication I

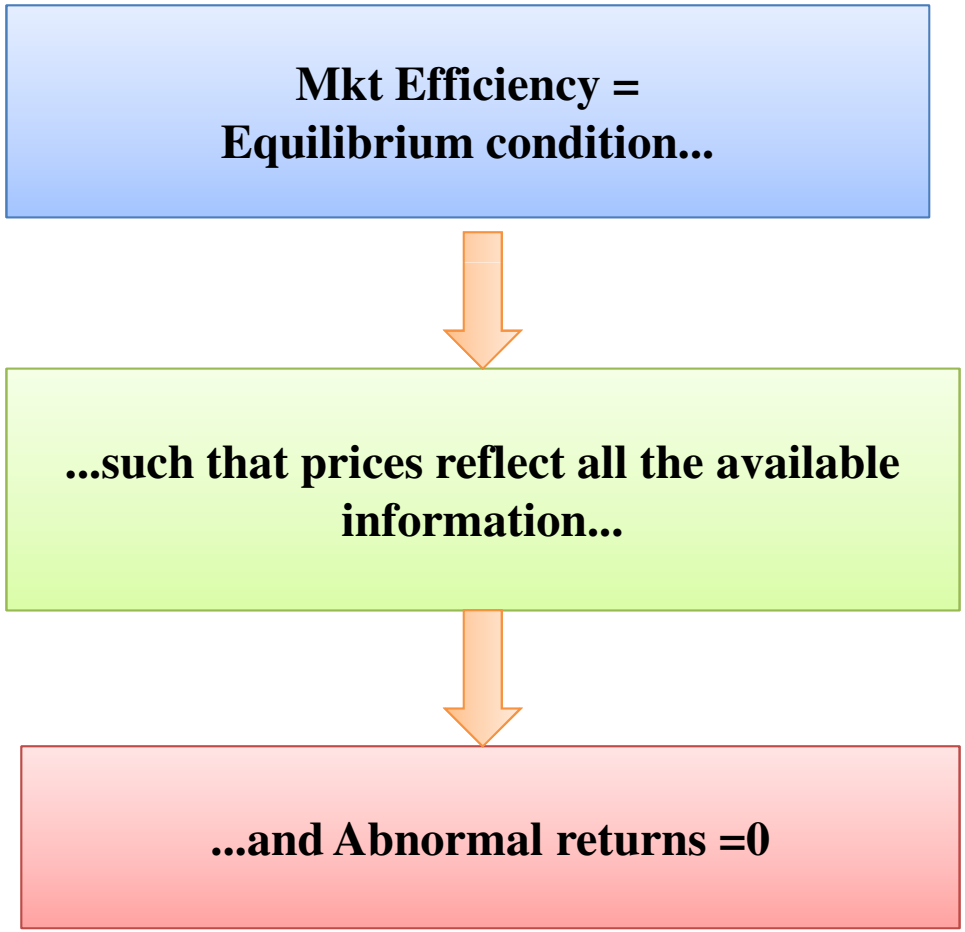
If markets are truly *efficient*, then no **abnormal returns** can be earned based on the knowledge of some available information

Abnormal return = Actual return - Return that would be expected if market prices reflected all the available information

Major implication II

Mkt Efficiency → **No abnormal returns** → **No profits from speculation**

How to test for mkt efficiency? I



How to test for mkt efficiency? II

In more mathematical terms…

$$\text{Market Equilibrium Prices} = f(\text{Available Information Set})$$

and

$$\text{Established Market Prices} = f(\text{Equilibrium Expected Values})$$

Practically, however, it is very difficult to carry out a statistical test, based on system of hp above (e.g. how to be sure we are using the right equilibrium model? How to test whether prices "conform" to their equilibrium expected values?)

How to test for mkt efficiency? III

Most empirical studies deal with market efficiency by testing the availability of abnormal risk-adjusted profit opportunities.

Existence of Statistically Significant
Abnormal Returns = Market Inefficiency

How to test for mkt efficiency? IV

The existence of statistically significant **risk-adjusted abnormal returns** is tested in a **twofold environment**.

CERTAINTY & RISK-FREE INVESTMENTS

↓

E[Equilibrium returns] = 0
(Can you explain why?)

↓

Are there statistically significant abnormal returns in excess of 0?

↓

Is **arbitrage** (why?) profitable?

Yes → **Inefficiency**

No → **Efficiency**

UNCERTAINTY & RISKY INVESTMENTS

↓

E[Equilibrium returns] = r ($r \neq 0$)
(Can you explain why?)

↓

Are there statistically significant abnormal returns in excess of r?

↓

Are **Spot** and/or **Forward speculation** (why?) profitable?

Yes → **Inefficiency**

No → **Efficiency**

Mkt Efficiency with Certainty and Risk-free investments

Mkt efficiency in the case of certainty and risk-free is mainly tested based on covered interest arbitrage

Most of the deviations from parity seem to be due to transaction costs, political risk, taxes…

Profit opportunities are more apparent than real

Markets are very likely to be efficient

Mkt Efficiency with Uncertainty and Risky investments

Mkt efficiency in the case of uncertainty and risky investments is tested both for spot and fwd speculation

Even after adjusting for transaction costs, speculation seems to result in significant profits

Markets are very likely to be inefficient

Spot speculation

Tests for mkt efficiency try to compute the profitability of various **technical trading strategies**

Technical analysis: trading approach that tries to forecast an economic variable based on the **pattern** of its past values → technical analysis assumes a certain level of **persistence** (i.e. $\rho(\Delta Var_t;\Delta Var_{t+1})>0$) in exchange rate movements

Watch out

Efficient mkts **do not** preclude the existence of price patterns!

Efficient mkts simply do not allow to exploit any knowledge of such patterns to earn abnormal profits

Technical trading strategies: some examples I

- *Filter rule* → once you have defined the filter size "f", the trading strategy works as follows:

Buy Signal

$$S(t) > (1+f) \cdot S(Min)$$

with S(Min)= most recent trough price

Sell Signal

$$S(t) < (1-f) \cdot S(Max)$$

with S(Max)= most recent peak price

Technical trading strategies: some examples II

- *MA rule* → the rule is based on the definition of a short term and of a long term MA, so that:

Buy Signal

MA(S, t) > MA(L, t)

with MA(S,t) = short term MA at time t and MA(L,t) = long term MA at time t

Sell Signal

MA(S, t) < MA(L, t)

Filter and MA Rules I

Source: Bloomberg, 18th January, 2013

Filter and MA Rules II

Source: Bloomberg, 25th January, 2013

Why should technical trading strategies be profitable?

- Exchange rates may not be random→ they could follow non-linear behaviours
- Central Bank interventions can create predictable patterns in FX rates, that would otherwise be efficient;
- Trading profits may be Non-Normally distributed, so that the duration of profitable positions exceeds the duration of non-profitable positions;

Mixed Evidence

The empirical evidence on technical analysis's profitability is much more controversial than it seems…

Some studies tend to support the claim that technical trading rules are profitable…

However…

Schulmeister (2005) examined the profitability of several technical trading strategies over 3 decades (from 1973 to 1999 and out-of-sample from 2000 to 2004)…

Watch out

- For each strategy, the number of profitable trades is lower than the number of unprofitable trades;
- Avg daily return (profitable positions) < Avg daily loss (unprofitable positions);
- Profitable positions last 3/5 times more than unprofitable positions→ profitability of technical trading rules = f (persistence in FX trends);
- The profitability of technical trading strategies has been significantly lower since the late ‘80s

Technical traders vs econometricians

Do FX rates trend or follow a random walk behaviour?

Failing to reject the "trend hp"…

is equivalent to concluding that spot speculation is profitable…

… and **markets** are thus very **likely to be inefficient**

Failing to reject the "random walk hp"…

is equivalent to concluding that spot speculation is unprofitable…

… and **markets** are thus very **likely to be efficient**

As expected, there are **no** easy conclusions to be drawn!

FX rates trends and the linear regression model I

$$\ln [Spot_t/Spot_{t-1}] = \beta_0 + \beta_1 \ln [Spot_{t-1}/Spot_{t-2}] + \varepsilon_t$$

Currency	Interval	N	β_1 (t-ratio)	R^2	F (probability)	D-W	Normality	Heteroscedasticity
DM	1-week	938	0.0378 (1.16)	0.001	1.34 (.248)	2.00	.000	.000
	1-month	216	-0.0073 (0.10)	0.000	0.01 (.915)	2.00	.008	.839
	1-quarter	72	0.0918 (0.76)	0.008	0.57 (.453)	1.90	.538	.735
UK	1-week	938	0.0310 (0.95)	0.001	0.90 (.342)	2.00	.000	.022
	1-month	216	0.1077 (1.59)	0.012	2.51 (.114)	2.01	.003	.147
	1-quarter	72	0.1984 (1.61)	0.036	2.59 (.112)	1.84	.683	.724
JY	1-week	938	0.0729 (2.23)	0.005	4.99 (.026)	2.01	.000	.006
	1-month	216	0.0633 (0.93)	0.004	0.86 (.354)	2.00	.115	.077
	1-quarter	72	0.1364 (1.15)	0.018	1.31 (.256)	1.97	.328	.472
CD	1-week	938	0.0474 (1.45)	0.002	2.11 (.147)	2.00	.000	.065
	1-month	216	-0.0680 (1.00)	0.005	0.99 (.321)	2.01	.000	.811
	1-quarter	72	0.1030 (0.86)	0.011	0.75 (.391)	1.99	.529	.225
SF	1-week	938	0.0139 (0.42)	0.000	0.18 (.671)	2.00	.000	.005
	1-month	216	0.0421 (0.62)	0.002	0.38 (.536)	2.01	.003	.292
	1-quarter	72	0.0364 (0.30)	0.001	0.09 (.765)	1.90	.922	.882

Notes:
1. Sample periods are January 3, 1975 - December 31, 1992 for weekly data; 1975:M1 - 1992:M12 for monthly data; and 1975:Q1 - 1992:Q4 for quarterly data
2. Regressions are estimated using OLS in MICROFIT version 3.0 software. Sample observations are non-overlapping.
3. Normality test is based on skewness and kurtosis of residuals. Statistic reports probability that residuals are normally distributed.
4. Heteroscedasticity test is based on a regression of squared residuals on squared fitted values. Statistic reports probability that residuals are homoscedastic.
5. T-ratio for β_1 in JY, 1-week interval is 1.89 using White's heteroscedastic-consistent estimate of the standard error. The p-value on β_1 is 0.059 with this adjustment.

FX rates trends and the linear regression model II

Given the small R^2 and taking also the t-statistics into account, **one may be lead to conclude that FX rates evolve as a random walk (= mkt inefficiency).**

This might be true, but **what if the relationship between ΔS_t and ΔS_{t+1} were not proportional?**

Forward speculation I

Tests of fwd mkt efficiency focus on the relationship among $F_{t,n}$, $E[S_{t+n}|I]$ and S_{t+n}

Under the general efficiency hp, it must be that:

$$E[S_{t+n}|I] = S_{t+n} \rightarrow \textbf{Rational Expectations}$$

and

$$F_{t,n} = E[S_{t+n}|I] + RP_{t,n} \rightarrow \textbf{Forward Rate Pricing}$$

Risk Premium

Forward speculation II

As already shown, the Forward rate is a **biased** predictor of the future Spot rate, at least in the short run.

If we can outperform the forward contract, the efficiency hp is automatically rejected

To sum up

The **evidence** on mkt efficiency is **mixed** at best:

Certainty and Risk-free Investments	Uncertainty and Risky Investments
The empirical evidence supports **efficiency** 	*Spot speculation*: The empirical evidence is substantially **mixed**  *Forward speculation*: The empirical evidence largely supports **inefficiency** 

The art of foreign exchange rate forecasting

The link between Mkt Efficiency & FX Forecasting I

The link between Mkt Efficiency & FX Forecasting II

The fact that mkt prices evolve according to predictable patterns does **not** imply mkt inefficiency in and of itself.

Indeed, mkts are said to be inefficient **iff** the **knowledge of such patterns leaves some room for profitable trading strategies.**

Are FX rates predictable?

Co-existence of two clashing views

☺

☹

Predictability

Non- predictability

Technical School
&
Fundamental School

Random Walk School

Those in favour…

- **Technical school** → exchange rates do follow predictable patterns in the **short run**
- **Fundamental school** → exchange rates do follow predictable patterns in the **long run**

Why is FX forecasting doable (and possibly profitable)?

- All you have to do is to get the right direction: accuracy is not an issue;
- FX mkt movements are likely to be predictable because of gvt interventions, overshooting…

Forecast Accuracy vs Usefulness

This can be thought of as a debate between **econometricians** and **market practitioners**.

Accuracy

Mean Squared Error

$$MSE = \frac{\sum_i \varepsilon_i^2}{n} = \frac{\sum_i \frac{\hat{S}_{t+j} - S_{t+j}}{S_{t+j}}}{n}$$

Usefulness

% Correct Forecasts

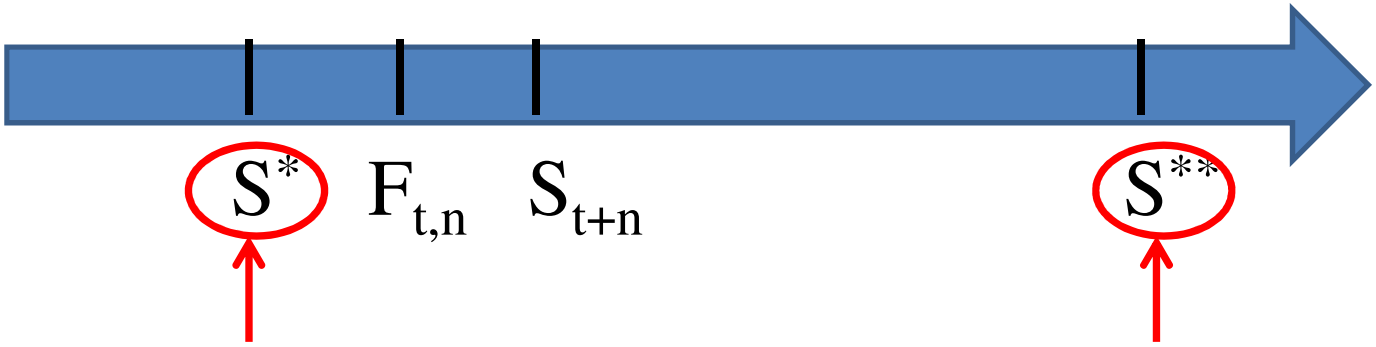
$$p = \frac{\#\text{ correct forecasts}}{\#\text{ forecasts}}$$

When is a forecast correct?

With S^*_{t+n} = n-periods ahead forecast

	$S_{t+n} > F_{t,n}$	$S_{t+n} < F_{t,n}$
$S^*_{t+n} > F_{t,n}$	☺	☹
$S^*_{t+n} < F_{t,n}$	☹	☺

The tradeoff



(on the right side)

Which one would you prefer?

Those all against…I

- **<u>Random walk school</u>** → FX rates cannot be forecast

Why is FX forecasting so difficult?

- Which model to use? Which macroeconomic variables to include?
- Which specification to use?
- How much past data?
- What about out-of-sample validity?

Those all against…II

- "**Economists do not yet understand the determinants** of short-to-medium run **movements** in exchange rates. **Neither models of exchange rates based on macroeconomic fundamentals nor the forecasts of market participants** as embodied in the forward rate or survey data **can explain exchange rate movements better than** a naïve alternative such as a **random walk model**" (R. Meese, 1990)

Those all against…III

- "It is now widely accepted that **standard observable macroeconomic variables are not capable of explaining**, much less predicting ex ante, the majority of **short-term changes in the exchange rate**"

(J. Frankel and K. Froot, 1990)

Watch out

When forecasting exchange rates, you cannot help take into consideration:

1. **Exchange Rate System**: Pegged, Floating, Hybrid…;
2. **Forecast Horizon**: ST, MT, LT…;
3. **Foreign Exchange Unit**: Nominal/Real rates…

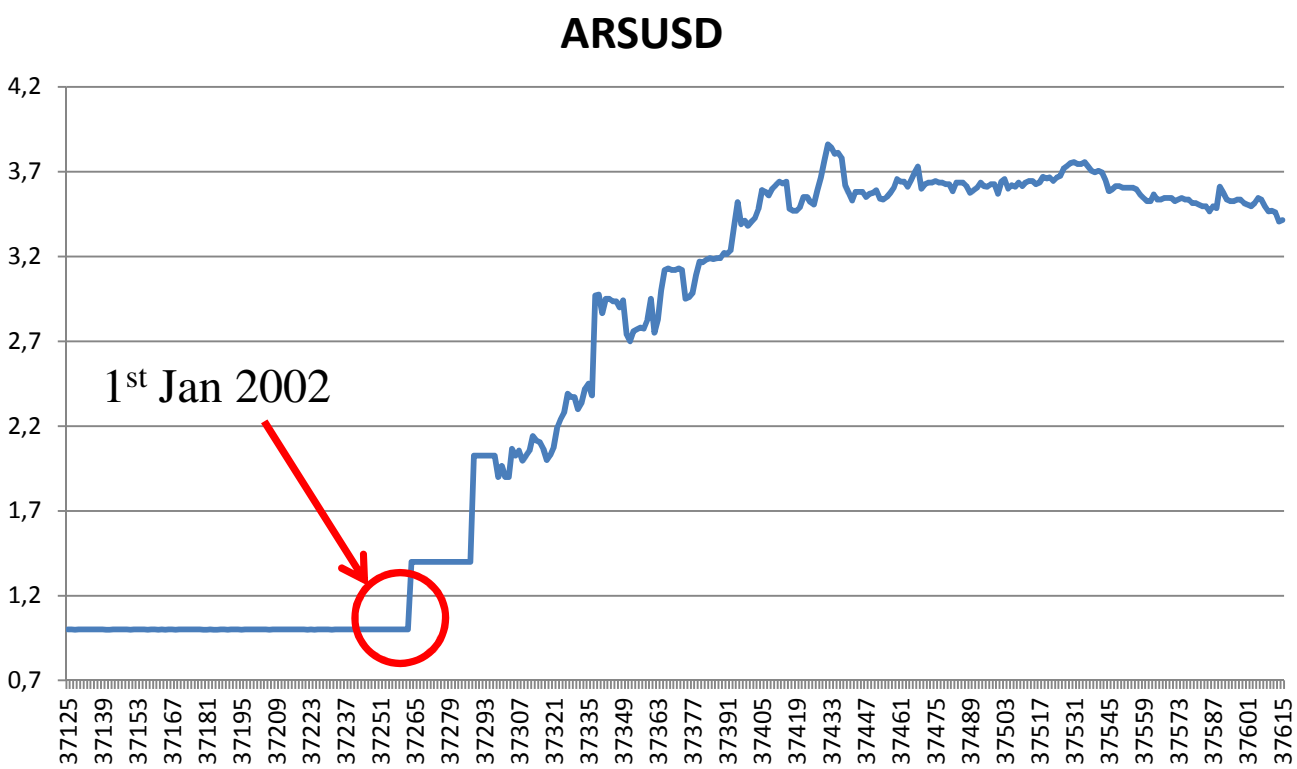
Terminology

Pegged Exchange Rate (or Fixed Exchange Rate): rate set by monetary authorities at selected, official levels

Exchange Rate regime

- ***Pegged rate regime***: irreversible deviations from the parity value are very likely to be identified → models may help predict the magnitude and the direction of the change in the parity value (timing is a political decision, although mkt speculation –and self-fulfilling prophecies- can speed it up)
- ***Floating rate regime***: profitable forecasting depends exclusively on the lack of efficiency

The Argentine Pesos



The Argentine Crisis 2000-2002 I

- 1st April 1991= the Peso was officially pegged to the USD @ 1 peso = 1 USD
- Necessary conditions for the success of fixed exchange rate regimes:
  1. The domestic currency must be freely convertible into the anchor currency
  2. The conversion rate must be clearly fixed
  3. The domestic currency must be fully backed with hard currency

The Argentine Crisis 2000-2002 II

- Argentina mainly lacked the 3rd condition→ excess of money creation over the backing: **"FIDUCIARY ISSUE"**
- Large fiscal deficits + the continuous strengthening of the USD made the situation even worse
- The stronger the dollar became, the weaker became the Argentine economy→ K started to leave massively the country and it gradually became clear that the CB was running short of reserves→ the peg was abandoned on 1st January 2002

Forecast Horizon

- **Short term forecasting**: major focus on technical models and on mkt reactions to macroeconomic releases
- **Long term forecasting**: greater reliance on macroeconomic fundamentals
- **Mid term forecasting**: several "special approaches" available → e.g. OTM options

Option pricing and Forecasting I

Consider a target zone with limits $\underline{S}$ and $\overline{S}$

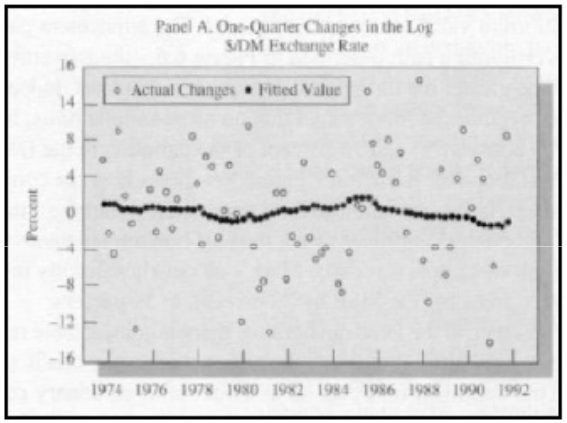
If the target zone is fully credible, realizations such as $S>\overline{S}$ or $S<\underline{S}$ are ruled out.

Calls whose strike price (K) $>\overline{S}$ and puts with strike $<\underline{S}$ should be worthless (**OUT of the MONEY**)

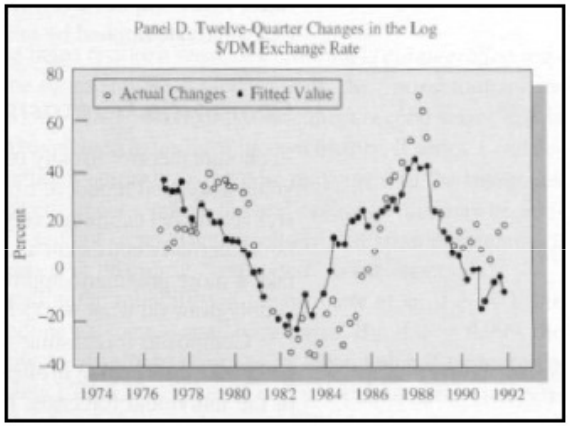
Option pricing and Forecasting II

The more expensive these options become, the likelier becomes the possibility of extreme occurrences outside the target zone

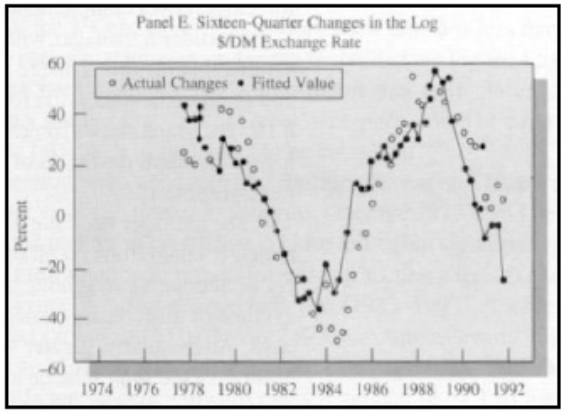
Forecasting Improves over the LT



1 Qtr



12 Qtr



16 Qtr

Source: Nelson Mark, "Exchange Rates and Fundamentals …," *Amer. Econ. Rev.*, March 1995.

Foreign Exchange Unit

Nominal and Real FX rates may be similar in the short run, but very different in the long run

- **Nominal** exchange rates are likely to be **non-stationary**;
- **Real** exchange rates are likely to be **stationary**

FX rate Forecasting: To sum up I

Short run	Medium run	Long run
• Technical Trading Models • FX responses to Macro news	• Technical Trading Models • OTM options	• Models based on macro fundamentals • Mean reverting behaviours (real exchange rate)

FX rate Forecasting: To sum up II

The available empirical findings show that some models have performed well at gauging the direction/magnitude of FX movements over specific time horizons (= the empirical evidence seems to favour FX forecasting).

- **Will these models hold out of sample** (namely outside the period used to fit the models to the data)**?**
- **There is no available universal model yet → only useful empirical findings**

To put it into practice

- Are mkt efficiency, forecasting and speculation somehow related? Please explain.
- How would you describe "technical" forecasting?
- Concerning exchange rate forecasting, _____ involves the use of historical exchange rate data to estimate future values, while ignoring the economic determinants of exchange rate movements.
  a. Econometric analysis
  b. Judgmental analysis
  c. Technical analysis
  d. Sunspot analysis