



OPERAČNÍ PROGRAM PRAHA
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EVROPSKÝ SOCIÁLNÍ FOND

Introduction to a Small Macro Model

PRAHA & EU

INVESTUJEME DO VAŠÍ BUDOUCNOSTI

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- Motivation
- Economic Background
 - New Keynesian Theory
 - Lucas Critique
- Model Equations in our Model
- Conclusion

- The model enables to produce economically consistent projections
- Without model, the forecast is purely an extrapolation of historical data or judgements
- The model is built to be transparent and simple
 - Central Bank models usually much more complicated
 - Broader analysis and judgments can be incorporated in the forecast
- The model provides (i) common language and represents (ii) a consensual view on the transmission mechanism
- Used for forecasting and monetary policy analysis (FPAS)
- „The only function of economic forecasting is to make astrology look respectable.“ J.K. Galbraith (US Canadian-born economist)

- The model is based on New Keynesian theory
 - Nominal and real rigidities
 - Monopolistic competition and sticky-prices in the short-run
 - Rational expectations
 - Derived from microeconomic foundations
 - But...coefficients are not derived from the microfounded model or using econometric approach
- We use a semi-structural or 'gap' model
 - Low maintenance cost
 - Very flexible and intuitive
 - Easy to calibrate
 - Mainly medium-term forecasting
 - Equations in log-linearized form

- Model ...
 - ... is structural
 - Every equation has economic interpretation
 - ...is general equilibrium
 - supply = demand
 - ... is stochastic
 - Random shocks affect each endogenous variable
 - ... incorporates rational expectations
 - There is no way to consistently fool economic agents

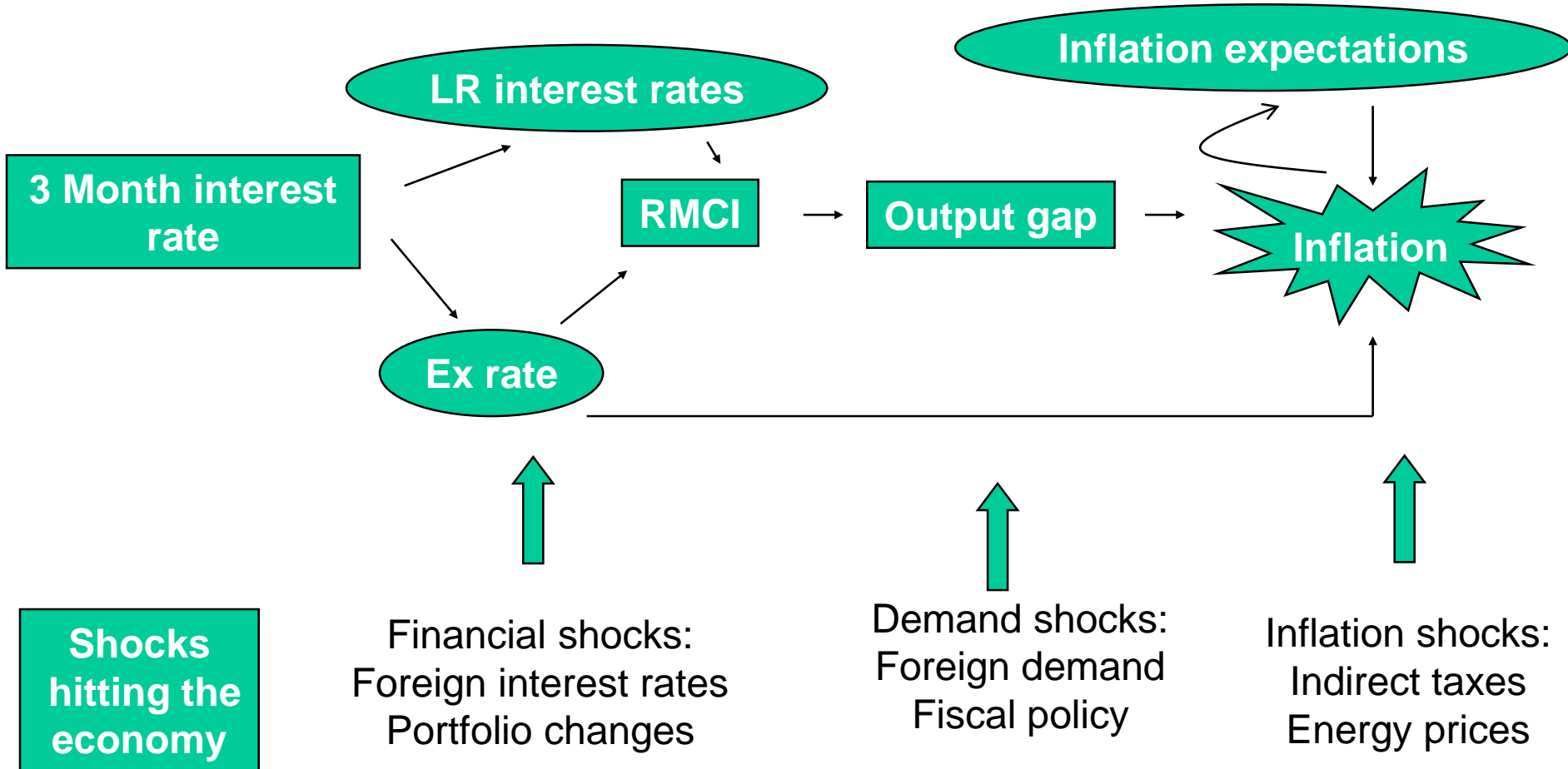
- Lucas improved the use of conventional models
 - His legacy: the expectation of the individuals about the system has to be incorporated in the model
 - Expectation is a social behaviour
 - With an change of the regime, the individuals also change their expectations
- Most economic decision are forward looking
- Forward looking model vs econometric model
 - Without rational expectation the model can't be good for medium-up-to-long-term forecasting
 - Might lead to wrong calibration
- This type of model is immune towards Lucas critique

- Works with only flow variables and has an exogenously well-defined long-run “steady-state” (equilibrium/trend)
- It analyses the business cycle around the “steady-state” (trend) values using “gaps”
- A “gap” is deviation of a particular variable from the “steady-state” (trend) value
 - Log-linearized approximation

$$\hat{y}_t \equiv 100 * \log(y_t / \bar{y}_t) \equiv l - y_t - l - \bar{y}_t$$

- A core model consists of 4 main behavioral equations:
 - Agregate demand (Real sector)
 - Agregate supply (Real sector)
 - Uncovered interest parity (UIP)
 - Policy Rule
- ...and External equations plus identities.
- Each real variable is decomposed to trend (equilibrium)
 - The model express each variable in terms of deviation from equilibrium
- Forward-looking (model-consistent expectations)
 - Inflation and exchange rate
- Policy analysis (Central bank part of the model)
- Open structure
 - Expert Judgments can be incorporated

- Transmission mechanism in gap model



- Relates monetary policy and real economic activity:
 - Own lagged value
 - Allows for inertia in the system → shocks which have persisting effects
 - Monetary policy
 - Nominal interest rate – sticky prices - real interest rate
 - Nominal exchange rate – sticky prices – real exchange rate
 - External developments

$$\hat{y}_t = a_1 \hat{y}_{t-1} - a_2 \hat{r}_t - a_3 \hat{z}_t + a_4 \hat{y}_t^* + \varepsilon_t^y$$



Output gap



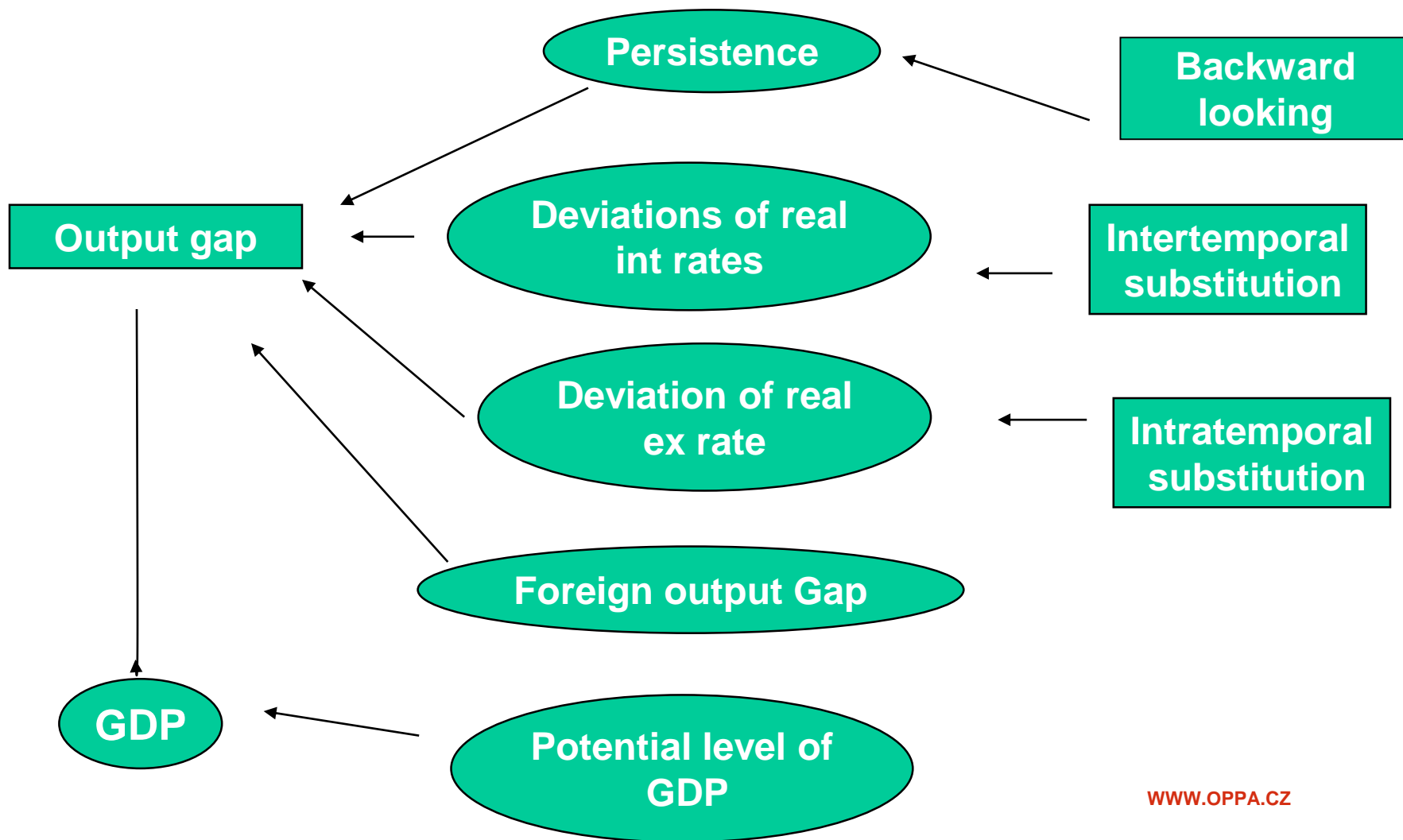
Monetary condition index



Foreign output gap



Aggregate demand shock

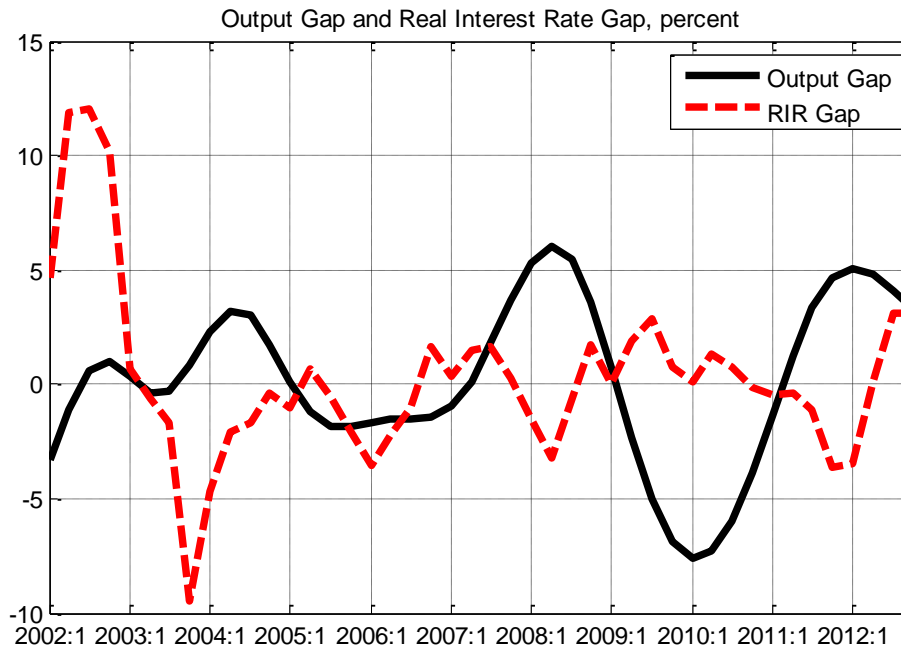


$$\hat{y}_t = a_1 \hat{y}_{t-1} - a_2 mci_t + a_3 \hat{y}_t^* + \varepsilon_t^y$$

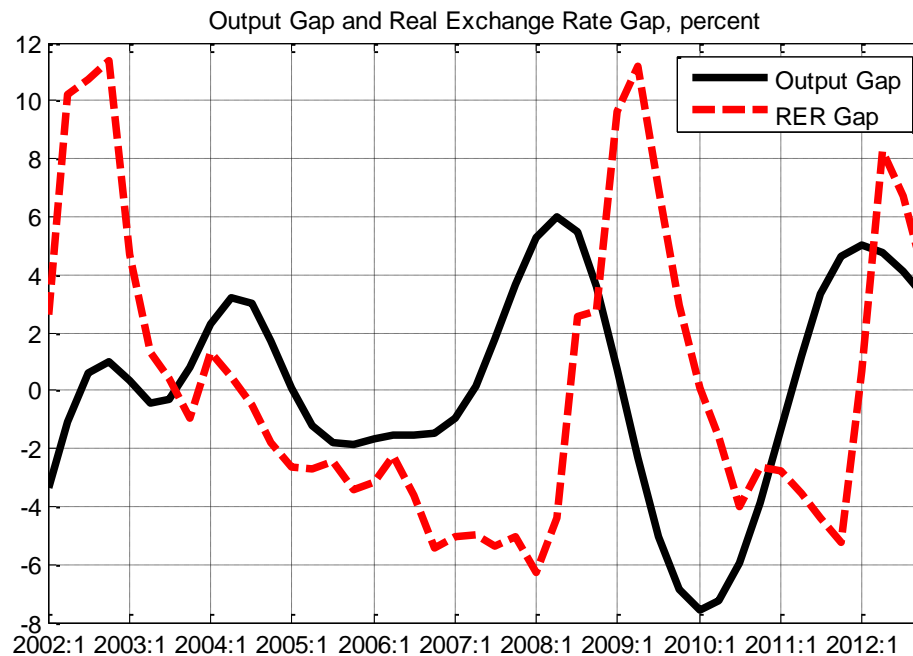
- a_3
- **Impact of foreign demand on the output gap**
- Typically varies between 0.1 and 0.5
- Calibration: base the calibration on OLS regression of the domestic output gap on foreign and or on the export to GDP ratio

$$mci_t = a_4 \hat{r}_t + (1 - a_4)(-\hat{z}_t)$$

- a_4
- **The relative weight of the real interest rate and real exchange rate in real monetary conditions in the IS curve** (monetary conditions index ... mci).
- The value varies between 0.3 (open economy) and 0.8 (closed economy)
- *Calibration*: Expert assessment.



- Relatively stable negative relationship between real interest rate and output



- Depends on
 - Expectations → backward- and/or forward-looking
 - World food prices and exchange rate – mainly
 - Domestic real economic activity – a little
 - Cost push shocks
- Monopolistic competition and sticky prices

$$\pi_t = b_1 \pi_{t-1} + (1 - b_1) \pi_{t+1}^e + b_2 rmc_t + \varepsilon_t^\pi$$

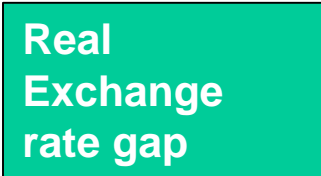

Headline
Inflation
Expected inflation
Real marginal cost

- Output gap approximates domestic inflationary pressure
 - Real marginal cost of domestic producers
- Real exchange rate gap approximates external inflationary pressure
 - Real marginal cost of importers

$$rmc_t = b_3 \hat{y}_t + (1 - b_3) \hat{z}_t$$



Output gap



Real
Exchange
rate gap

$$\pi_t = b_1 \pi_{t-1} + (1 - b_1) \pi_{t+1}^e + b_2 rmc_t + \varepsilon_t^\pi$$

 b_1

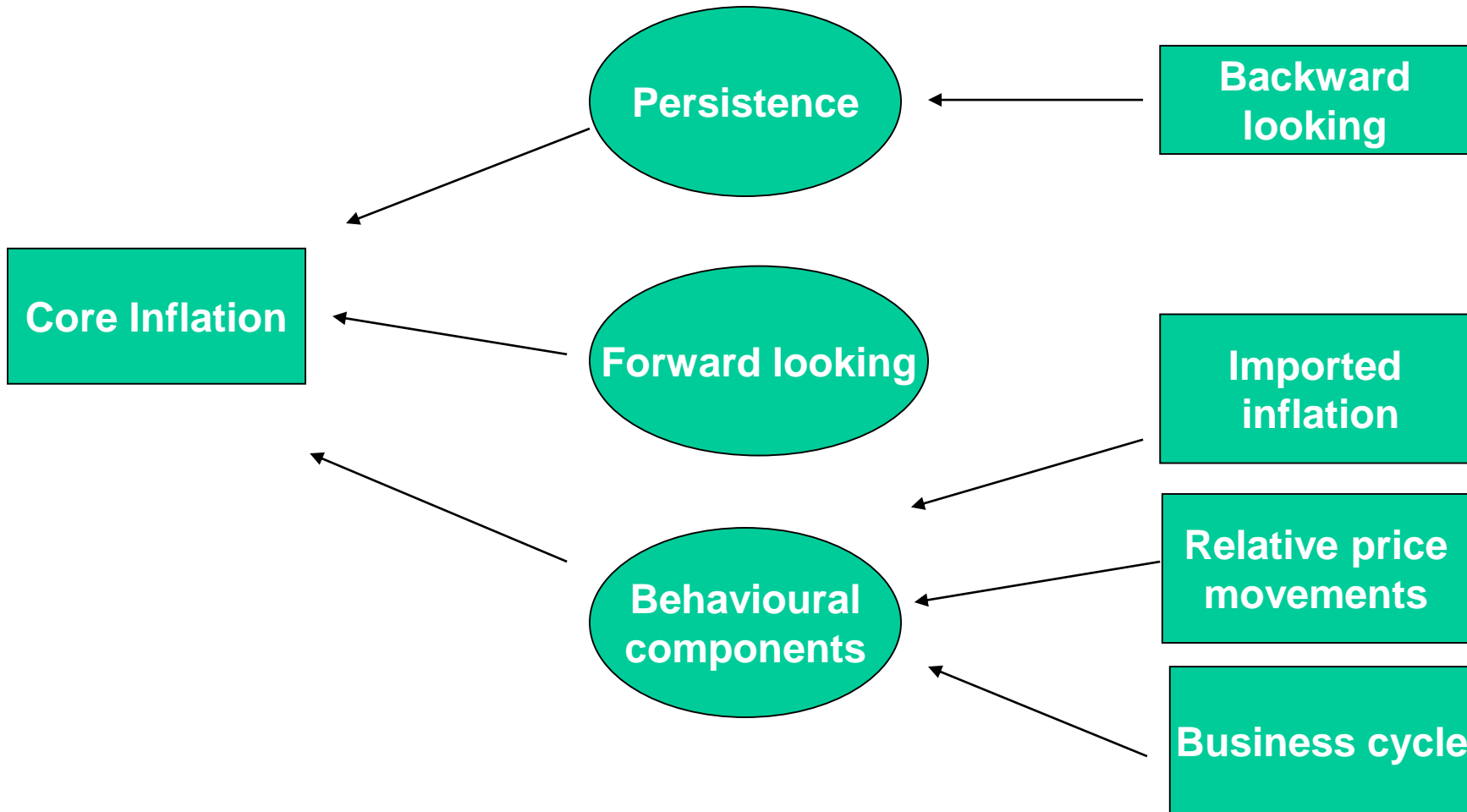
- **Inflation persistence.** Share of forward looking agents on the goods markets
- Varies between 0.4 (low persistence) and 0.9.
The higher is the share of forward looking agents the less pronounced policy reactions are required
- Calibration: start with 0.5 and adjust according to the model performance

$$\pi_t = b_1 \pi_{t-1} + (1 - b_1) \pi_{t+1}^e + b_2 rmc_t + \varepsilon_t^\pi$$

- Monetary policy influences inflation through its effects on output and the exchange rate thus, the coefficients on the output and exchange rate gaps must be greater than zero or else MP has no effect on inflation.

 b_3

- higher in economies that are very open
- Higher exchange rate pass-through is associated with countries where MP credibility is low
- What factors impact the exchange rate pass-through?



- Two Phillips curves
- The Phillips curve describes the trade-off between prices and output
- Summed based on the weight of their relative components
- In developed countries, weight of food in CPI is about 10-20%. In emerging countries, the weight of food ranges between 30-50%

$$\pi_t = w^{\text{food}} \pi_t^{\text{food}} + (1 - w^{\text{food}}) \pi_t^{\text{core}}$$

- Relates domestic and foreign interest rate with expected change in the exchange rate (capital inflows)
 - Domestic/foreign interest rate
 - Country premium
 - Current and expected exchange rate
- The expected return on a short-term investment is the same when ignoring country risk premiums at home and abroad.

$$s_t = s_{t+1}^e + (i_t^* - i_t + prem_t) / 4 + \varepsilon_t^s$$

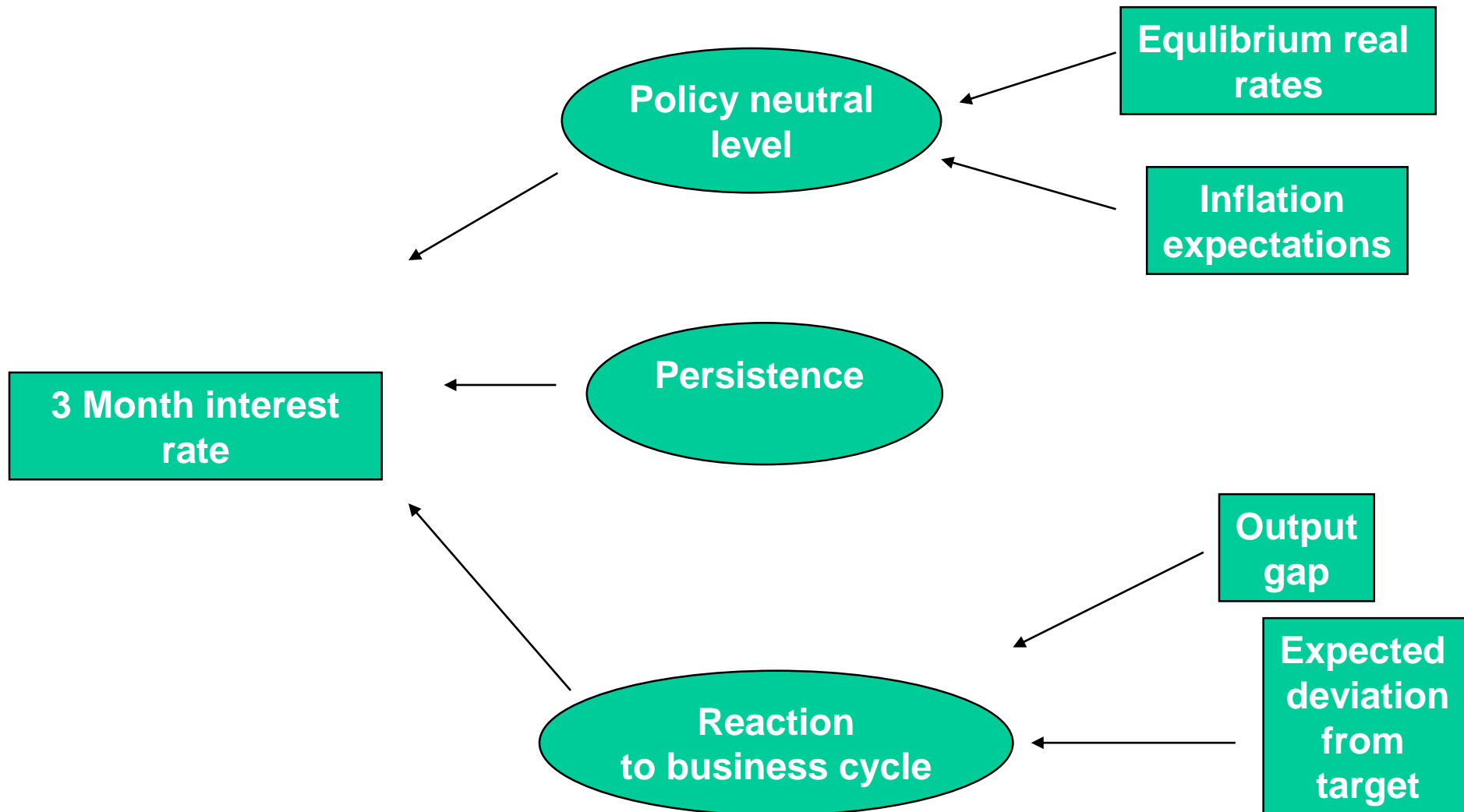
- Monetary Reaction Function

$$i_t = f_1 i_{t-1} + (1 - f_1)(i_t^n + f_2(\pi_{t+1}^e - \pi^T) + f_3 \hat{y}_t) + \varepsilon_t^i$$

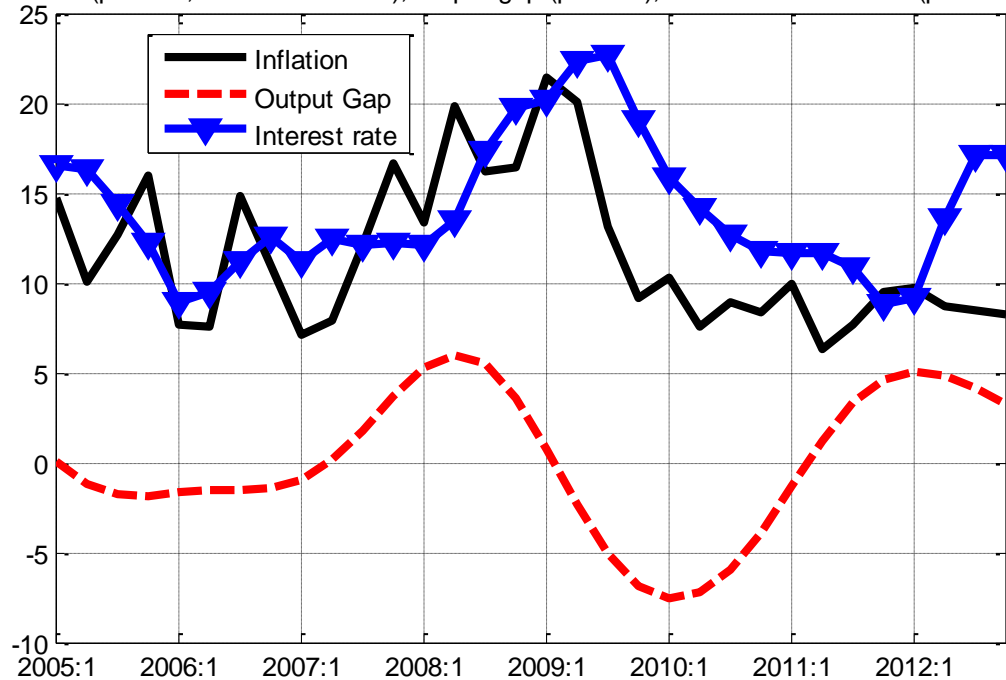
- Describes the manner in which monetary policy is conducted
- Neutral nominal rate = trend real interest rate + model-consistent inflation expectations

$$i_t^n = \bar{r} + \pi_{t+1}^e$$

- Monetary authority sets a path for interest rates that anchors inflation expectations to the target.
- Lagged term provides interest smoothing where CB responds gradually.
- Output gap: policy decisions depend on more than just inflation expectations.



Inflation (percent, QoQ annualized), output gap (percent), nominal interest rate (percent p.a.)



- The interest rate reacts nicely to inflation, with a slight lag only

- No explicit modeling of the supply side and current account
 - Captured indirectly through other endogenous variable
- No stock-flow consistency...
 - From investment to capital level, output level and back
- No stock and assets equilibriums
 - How to model crises?
- No explicit modeling of central bank “credibility”

However, all these limitations can be at least partially overcome by extending and adjusting the framework

- Calibration of a model should reflect stylized facts about the economy and the dynamics between variables
- Parameters are set on the basis of model properties
- Restriction from economic theory

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Thank you for your attention!

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