# Elements of Econometrics. 2022-2023.
# Class 17. Dynamic Models.

## Partial Adjustment model

**Problem 1. (Theoretical exercise).** Explain how ADL(1,0) model relates to the partial adjustment model. Explain the structure and the meaning of parameters of the partial adjustment model. How this model can be estimated? What are properties of obtained estimates?

**Problem 2. (Theoretical exercise).** Explain the structure and the meaning of parameters of the partial adjustment model.

**Problem 3. (Theoretical exercise).** What are dynamic properties of the partial adjustment model? What are the differences between short run and long run behavior in the partial adjustment model?

**Problem 4. (Practice exercise).** Illustrate topics discussed in Problems 1-3 using regression of the expenditures on clothes (CLOT) on disposable personal income (DPI) and lagged CLOT(-1).

## Adaptive expectations model

**Problem 5. (Theoretical exercise).** Explain the structure and the meaning of parameters of the adaptive expectation model.

**Problem 6. (Theoretical exercise).** What ADL models are connected with the adaptive expectation model?

**Problem 7. (Theoretical exercise).** Explain how Koyck distribution model can be obtained from the adaptive expectation model?

**Problem 8. (Theoretical exercise).** How Koyck distribution model can be estimated using direct search? What are the properties of estimators obtained in this method?

**Problem 9. (Practice exercise).** Illustrate topics discussed in Problem 4 5 using regression of the expenditures on houses (HOUS) on disposable personal income (DPI) and its lagged values. Compare different techniques of estimation.

**Problem 10. (Theoretical and practice exercise).** How Koyck distribution model can be estimated using non-linear technique? Illustrate it on the previous example.

**Problem 11. (Theoretical exercise).** How to use Koyck transformation for estimation of parameters of adaptive expectation model using Koyck distribution with infinite number of lags;

**Problem 12. (Theoretical exercise).** How to make Koyck transformation directly without using Koyck distribution?

**Problem 13. (Theoretical exercise).** What are properties of estimators obtained in Koyck transformation directly without using Koyck distribution?

**Problem 14. (Theoretical exercise).** Using Koyck transformation explain the difference between short run and long run dynamics in adaptive expectation model.

## ADL(p,q) model of the general type

**Problem 15. (Theoretical exercise).** How to analyse the short run and long run dynamics in the ADL(p,q) model of the general type? How to use decomposition of the distributive lags model into long run and short run components?

**Problem 16. (Theoretical exercise).** What is error correction model and how it is connected with the partial adjustment model?

**Problem 17. (UoL and ICEF Exams). Investigation of Dynamics of the Partial Adjustment Model.**
A researcher has annual time series data on labour employed, $L_t$, measured in thousands of employees, output, $Y_t$, measured in billion dollars at constant prices, and average annual wages, $w_t$, measured in thousands of dollars at constant prices, for a certain industry for 25 years and fits the following regression (standard errors in parentheses; $d$ is the Durbin-Watson statistic):

$$L_t = 10.11 + 6.13Y_t - 0.21w_t + 0.80L_{t-1} \qquad d = 1.88$$
$$(1.91)\ \ (1.20)\ \ \ (0.14)\ \ \ (0.10)$$

**(a)** Explain how the model may be interpreted as a partial adjustment model

**(b)** Analyse dynamic behaviour of the model.

**(c)** Perform appropriate statistical tests for coefficients of the model. Discuss what changes if one-sided tests are applied. What assumptions are needed for that? What could be said on the fulfilling Gauss-Markov conditions for the disturbance term of the model?

The researcher fits a logarithmic version of the same model, using the same data:

$$\widehat{\log L_t} = 0.18 + 0.14\log Y_t - 0.12\log w_t + 0.82\log L_{t-1} \qquad d = 1.90$$
$$(0.03)\ (0.03)\qquad (0.06)\qquad (0.10)$$

**(d)** Again, briefly provide an interpretation of the short run and the long run dynamics of the regression and perform appropriate statistical tests.

**Problem 18. (UoL and ICEF Exams). Investigation of Dynamics of the Adaptive Expectations Model.**
Consider a model

$$Q_t = \alpha + \beta P_t^* + \gamma Z_t + u_t;\ t = 1, 2, ..., T \qquad (1)$$

where $Q_t$ is the supply of wheat from the farmers of a particular country, $P_t$ is the price of wheat (£) and $Z_t$ is a measure of rainfall in this country. These three variables are observed. Price expectations $P_t^*$ are revised by $P_t^* = \lambda P_{t-1} + (1-\lambda)P_{t-1}^*$. $u_t$ is a random error, such that $E(u_t) = 0$; $E(u_t^2) = \sigma^2$ and $E(u_s u_t) = 0$ if $s \neq t$ for all $s, t = 1, 2, ...., T$.

**(a)** Show that this model can be reduced to infinite distributed lags model of the type

$$Q_t = \alpha + \beta\sum_{j=0}^{\infty}\mu^j P_{t-j-1} + \gamma Z_t + \varepsilon_t \qquad (2)$$

**(b)** How the models of the type (2) could be estimated?

**(c)** Show that the infinite distributed lags model of the type (2) can be written in terms of a single lag $P_{t-1}$. What estimation problems may occur in this model (besides the problem of serial correlation which is discussed later in e)?

**(d)** Derive the short run and long run effect of *P* on *Q*.

**(e)** Derive an econometric model in observable quantities directly using Koyck transformation (without using infinite lags). Discuss problems connected with serial correlation in the obtained model.