

# FORECASTING THE CYPRUS GDP GROWTH RATE: Methods and Results for 2017

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## Forecasting at the Economic Research Centre (ERC)

- The Centre's objective is to develop the technical infrastructure for producing **independent, short-term forecasts (up to 8 quarters ahead)** of various key economic aggregates.
- Forecasts are produced using **cutting-edge econometrics techniques** (also used at the ECB, the Fed Reserve board, other Central Banks and research centers abroad).
- Our forecasts for the Cyprus GDP growth are **released systematically** – *every quarter since 2012*.
- Policy makers, such as the Central Bank of Cyprus, the Ministry of Finance and the IMF, are interested in our forecasts.

# Forecasting at the Economic Research Centre (ERC)

- Our forecasts
  - (1) are based on a **large and comprehensive dataset** including domestic and foreign indicators.
  - (2) are obtained via the estimation of a **large number of alternative models** based
    - on **predictors and leading indicators** and
    - **common factors extracted** from a large panel of domestic and foreign real activity and the labour market indicators.
- The final forecast for each quarter is estimated as a weighted average of all models forecasts using weights based on the historical forecasting performance/error of each model (**forecast combination**), addressing **model uncertainty**.

# Forecasting Methodology and Results for 2017

1. Database of predictors description
2. Methodology
  - Forecasting Models
  - Common factors extraction
  - Rating predictability
  - Forecast combinations
3. Empirical results for the 2017 forecasts
4. Future directions

# Our database is a panel of:

**N = 330 variables (190 domestic and 140 foreign)**

**T = 1995Q1-2016Q3**

## **DATABASE SOURCES:**

- (1) Cyprus Statistical Service**
- (2) Central Bank of Cyprus**
- (3) Cyprus Stock Exchange**
- (4) JCC**
- (5) Cadastre**
- (6) Eurostat**
- (7) European Commission DG-ECFIN**
- (8) Global Financial Data**
- (9) Datastream**
- (10) ECB**

# Data description: Domestic variables

- Seasonally adjusted first release data
- National accounts (GDP, added value of sectors, gross capital investment ...) (26 series)
- Short-term economic indicators (retail, construction, manufacturing, energy) (25 series)
- Employment, unemployment, vacancies, compensation of employees (38 series)
- Imports, exports, tourism (29 series)
- Fiscal (7 series)
- Deposits, loans, interest rates (31 series)
- Cyprus Business and Consumer Surveys (23 series)
- Prices and CSE indicators (9 series)
- The largest group of **domestic variables relate to economic activity and the labour market containing around 30% of the total series.**



# Data description: Foreign variables

- Exchange rates (6 series)
- Foreign activity and labour market indicators (e.g. GDP EU, EA, UK, RUS,...) (42 series)
- International financial and foreign price indicators (European interest rates and spreads, ATHEX, DAX, FTSE, oil prices, gold, ...) (71 series)
- European Business and Consumer Surveys (24 series)
- **Foreign series mainly refer to financial indicators, activity and the labour market variables, which cover 80% of the international variables.**
- We use **stationary data** based on unit root tests and following the literature on factor model estimation (e.g. Stock and Watson, 2008, Ludvigson and Ng, 2009).

# Methodology: Models

One of our objectives is to predict the annualized GDP growth rate in the next quarter:

$$Y_{t+1} = 400 \ln(GDP_{t+1} / GDP_t)$$

The Random Walk model (for  $\ln GDP_{t+1}$ ) or constant mean ( $\mu$ ) growth model is taken as the benchmark:

$$Y_{t+1} = \mu + u_{t+1}$$

# Methodology: Models

Forecasts for horizon  $h$  periods (1-8 quarters) ahead are estimated from:

AR models (information from the past/lags of  $Y_t$ )

$$Y_{t+h}^h = \alpha + \sum_{i=0}^q \beta_i Y_{t-i} + u_{t+h}^h$$

ADL-X models (with lags and leads) (additional past/lagged information from **other predictors**,  $X_t$ , *not* related directly the real economy, **such interest rates, stock market indicators, economic sentiment, fiscal variables** e.t.c.)

$$Y_{t+h}^h = \alpha + \sum_{i=0}^q \gamma_i Y_{t-i} + \sum_{i=0}^p \beta_i X_{t-i} + \underbrace{\delta_1 X_{t+1}^{M1} + \delta_2 X_{t+1}^{M2}}_{\text{monthly leads}} + e_{t+h}^h$$

$$Y_{t+h}^h = \alpha + \sum_{i=0}^q \gamma_i Y_{t-i} + \sum_{i=0}^p \beta_i X_{t-i} + \underbrace{\delta_1 X_{t+1}}_{\text{quarterly lead}} + e_{t+h}^h$$

where  $X_{t+1}^{M1}$  and  $X_{t+1}^{M2}$  are the monthly leads of  $X_t$  covering the 1st and 2nd month of quarter  $t + 1$ , respectively;  $X_{t+1}$  is the quarterly lead of  $X_t$ .

# Methodology: Models

**Factor-ADL (FADL) models** are based on information from estimated common “**real economy**” Factors,  $\hat{F}$ , summarizing **domestic and real activity and labour market variables**.

**(A) FADL with only Factors and real economic variables leads** (and e.g. two months of leads,  $R_{t+1}^{M1}$  and  $R_{t+1}^{M2}$  in quarter t+1, of real economy variables used in the construction of factors):

$$Y_{t+h}^h = \alpha + \sum_{i=0}^q \beta_i Y_{t-i} + \sum_{i=0}^p \gamma_i \hat{F}_{t-i} + \delta_1 R_{t+1}^{M1} + \delta_2 R_{t+1}^{M2} + e_{t+h}^h$$

**(B) FADL-X with Factors and with real economic variables and other variables,  $X_t$** , (e.g. financials, economic sentiments e.t.c.) and their leads

$$Y_{t+h}^h = \alpha + \sum_{i=0}^q \beta_i Y_{t-i} + \sum_{i=0}^s \phi_i \hat{F}_{t-i} + \psi_1 R_{t+1}^{M1} + \psi_2 R_{t+1}^{M2} + \sum_{i=0}^p \gamma_i X_{t-i} + \delta_1 X_{t+1}^{M1} + \delta_2 X_{t+1}^{M2} + \varepsilon_{t+h}^h$$

# Methodology: Common Factor Extraction

- Technique that uses information from a large number of economic series and sums them up with a smaller number of common trends/factors ( $F_t$ )
- Let  $\mathbf{X}_t = (X_{1t}, X_{2t}, \dots, X_{Nt})'$  be a vector of **(real economy) predictors**

$$\mathbf{X}_t = \Lambda \mathbf{F}_t + \boldsymbol{\eta}_t$$

for  $t = 1, 2, \dots, T$ , where  $\mathbf{F}_t = (f_t', f_{t-1}', \dots, f_{t-q}')'$ ,  $f_t$  denotes the vector of  $r$  common *dynamic* factors,  $\boldsymbol{\eta}_t = (\eta_{1t}, \eta_{2t}, \dots, \eta_{Nt})'$ ,  $\eta_{it}$  is the idiosyncratic error,  $\Lambda$  is the matrix of factor loadings.

- The ordinary least squares estimation of factors  $F_t$  and factor loadings  $\Lambda$  is achieved by the **principal component method**.
- The choice of the number of factors is based on **information criteria** (Bai and Ng 2002). The conditional relevance of the factors estimated is also addressed via the **forecast combination methods**. Factors are also estimated recursively in the forecasting period.

## Methodology: Models

- Prediction horizons  $h = 1, 2, 4, \dots, 8$  quarters are used
- The sample of  $T+h$  observations is separated into the estimation period (in-sample) *1995Q1-2016Q2* and the forecasting period (out-of-sample) *2016Q3, 2016Q4, \dots, 2017Q4*.
- Parameters' estimation with recursive estimation: increase of the sample at a quarter each time, revaluation and calculation of prediction
- Advantages of recursive estimation for short time series and for samples with potential instabilities

# Methodology: Rating predictability

## Root mean squared forecast error – RMSFE

$$RMSFE_i = \sqrt{\frac{1}{T_1 - T_0 + 1} \sum_{t=T_0}^{T_1} (Y_{t+h}^h - \hat{Y}_{i,t+h|t}^h)^2}$$

$\hat{Y}_{i,t+h|t}^h$  : prediction from the model  $i$  that is made at period  $t$  and refers to the future period  $t+h$

$Y_{t+h}^h$  : value of the variable  $Y$  at period  $t+h$

$T_0$  : point when the first prediction is made (pseudo-out-of sample forecast)

$T_1$  : point when the last prediction is made

e.g.  $h=1$ ,  $T_0$ : 2002Q2,  $T_1$ : 2016Q2



## Methodology: Forecast combinations

- Our forecasting exercise each quarter uses a **large number of (1) predictors** and **(2) an even larger set of models**
- Reduce model uncertainty using forecast combinations
- Prediction from the combination of predictions from  $M$  models:

$$\hat{f}_{M,t+h|t} = \sum_{i=1}^M \hat{w}_{i,t} \hat{Y}_{i,t+h|t}$$

$\hat{Y}_{i,t+h|t}$  : prediction from the model  $i$  for the  $t+h$  period

$\hat{w}_{i,t}$  : estimated weights of the prediction from model  $i$   
(usually based on the historical performance of the model / forecast error)



## Methodology: Forecast combination methods

- (1) Mean** based on the average of all forecasts
- (2) Median** “middle” forecast
- (3) Trimmed mean** (5%)
- (4) Recently Best:** prediction from the model with the **lowest Forecast error** (RMSFE) on average, **in the last  $n$  periods ( $n=4$ )**
- (5) Discounted MSFE:** **weighted mean** of the individual predictions where the weighting inversely proportional to the discounted RMSFE (DMSFE) or the squared (2DSMFE) (e.g. discount factor  $\delta=0.9, 0.95$  (**greater weight to more recent good performance**))



# Forecasting GDP growth rate in 2017

- Based on our aforementioned methodology, we forecast the **annual GDP growth to reach 3.2% in 2017**.
- Table 1 shows that in the first and second half of 2017, real GDP is projected to rise to 3.3% and 3.1%, respectively.
- Forecast errors are also reported (as expected errors are larger for quarters closer to the end of the forecast horizon).
- Table 1 also shows the contribution of different components (groups of models) towards shaping the final forecasts. ***The real economy common factors (driven by domestic and foreign activity and labour markets) jointly with other indicators (mainly financial indicators, economic sentiment e.t.c.)*** play a key role in determining the forecasts. These are the **FADL-X group of models**.

## Table 1: 2017 GDP growth forecasts and component's contribution to forecasts

<u>2017 annual GDP growth FORECAST</u>	<b>3.2</b>			
Year Quarter	2017Q1	2017Q2	2017Q3	2017Q4
<u>QUARTERLY FORECAST (y-o-y)</u>	<b>3.4</b>	<b>3.3</b>	<b>3.1</b>	<b>3.0</b>
Forecast error (RMSFE)	2.3	3.0	3.5	4.0
<u>COMPONENTS/MODELS CONTRIBUTION:</u>				
<b>A. Real Economy (FADL: Domestic &amp; Foreign Activity &amp; Labour markets Common Factors)</b>	<b>0.02</b>	<b>0.02</b>	<b>0.01</b>	<b>0.01</b>
<b>B. Excluding Real Economy/Factors (ADL-X: Financials, Econ Sentiment, e.t.c)</b>	<b>0.04</b>	<b>0.04</b>	<b>0.03</b>	<b>0.03</b>
<b>C. Real Economy/Factors &amp; the following groups of indicators (FADL-X):</b>	<b>3.30</b>	<b>3.28</b>	<b>3.08</b>	<b>2.99</b>
- Fiscal	0.25	0.26	0.23	0.22
- Prices	0.54	0.54	0.51	0.51
- Exchange rates	0.09	0.09	0.09	0.08
- Interest rates, spreads	0.82	0.77	0.77	0.81
- Stock markets	0.59	0.61	0.55	0.48
- Economic sentiment	0.68	0.64	0.53	0.46
- Loans, deposits	0.32	0.38	0.39	0.43

## Table 2: 2017 GDP growth Forecasts: Weights and Forecasts by component

	WEIGHT				FORECAST BY COMPONENT			
2017 Quarter	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b><u>Components/Models Contribution:</u></b>								
<b>A. Real Economy (FADL: Domestic &amp; Foreign Activity &amp; Labour markets Common Factors)</b>	0.51	0.53	0.51	0.48	3.2	3.0	2.9	2.9
<b>B. Excluding Real Economy/Factors (ADL-X: Financials, Econ Sentiment, e.t.c)</b>	1.21	1.19	1.11	1.09	3.2	3.2	3.1	2.9
<b>C. Real Economy/Factors &amp; following groups of indicators (FADL-X):</b>	<b>98.28</b>	<b>98.27</b>	<b>98.37</b>	<b>98.43</b>	<b>3.4</b>	<b>3.3</b>	<b>3.1</b>	<b>3.0</b>
- Fiscal	6.99	7.13	7.11	6.76	3.6	3.6	3.3	3.2
- Prices	<b>15.95</b>	<b>15.98</b>	<b>16.16</b>	<b>16.17</b>	<b>3.4</b>	<b>3.4</b>	<b>3.2</b>	<b>3.1</b>
- Exchange rates	2.94	3.07	3.16	3.06	3.1	3.0	2.7	2.8
- Interest rates, spreads	<b>26.75</b>	<b>26.34</b>	<b>29.25</b>	<b>34.15</b>	<b>3.1</b>	<b>2.9</b>	<b>2.6</b>	<b>2.4</b>
- Stock markets	<b>17.02</b>	<b>17.42</b>	<b>16.51</b>	<b>14.57</b>	<b>3.5</b>	<b>3.5</b>	<b>3.4</b>	<b>3.3</b>
- Economic sentiment	<b>20.92</b>	<b>21.11</b>	<b>18.66</b>	<b>15.74</b>	<b>3.3</b>	<b>3.0</b>	<b>2.8</b>	<b>2.9</b>
- Loans and Deposits	7.69	7.23	7.53	7.98	4.2	5.2	5.2	5.3

**The recovery of the Cypriot economy is estimated to strengthen vis-à-vis 2016 as real GDP is projected to increase by 3.2% in 2017.**

The **main drivers** of the projected increase in real GDP are:

- (1) Real GDP continued to rise, employment growth accelerated and the unemployment rate declined** in 2016Q2; domestic leading indicators, including economic sentiment, continued to pick up during 2016Q3.
- (2) The improved fiscal performance.**
- (3) The long period of past declines in international oil prices.**
- (4) The rise in deposits, combined with deleveraging**, results in a declining loan-to-deposit ratio, suggesting improved conditions in the domestic banking sector. However, if the reduction in the stock of loans leads to increased real estate assets for banks, this may lead to instabilities if property prices fall.
- (5) The positive external economic environment** (marked by steady levels of economic confidence, moderate growth rates in the EU and the euro area, and low levels of European interest rates). Nevertheless, the long period of near-zero interest rates implies conditions of sluggish demand.



**DOWNSIDE RISKS** to the growth projections are associated with:

- (1) **A slowdown in output growth in the UK** and **depreciation of the pound** against the euro (due to the Brexit vote) will affect the Cypriot economy, primarily through tourism services.
- (2) **Potential decreases in euro growth rates** as a result of a larger than anticipated negative impact on member states' exports to the UK, and uncertainty regarding the Brexit.
- (3) In the domestic banking sector the **high private indebtedness levels** and **increased default rates** continue to pose significant risks, especially in conditions of low real estate prices and property demand.
- (4) **The high public debt-to-GDP ratio** renders Cyprus vulnerable to external negative shocks; thus delays in the advancement of structural reforms may create risks to public finances, Cyprus's credibility and market borrowing costs, particularly during a period of high risk aversion in international markets.

**Upside risks** to the outlook: (1) an improved performance of the **Russian economy** as oil prices are rebounding, and (2) **new investment projects** linked to tourism, energy and public infrastructure.



## Current and Future directions in Forecasting at the ERC

- The official forecasts and analysis for 2018 will appear in ERC's Economic Outlook July issue. However, internally we run the models and a preliminary forecast based on the [new National Accounts data \(Dec 2016\)](#) projects the annual [GDP growth rate of 2.8% for 2018](#), given the current state of the economy.
- There are a number of caveats in the 2018 forecast given the current political and economic uncertainty in Cyprus as well as Europe.
- With the financial support of the CBC and MoF we are extending our analysis to forecasts on the production side of the economy.
- **Sectoral Forecasts:** We construct short-term forecasts for the growth rate of gross value added (GVA) of sectors.
- Preliminary results show that information from macro & financial indicators as well as forecast combinations are useful for forecasting [certain sectors](#).



## Current and Future directions in Forecasting at the ERC

- **Nowcasting** involves using current and updated releases of information to revise current and near-future economic growth forecasts (given that the actual data on GDP and related series are available with delay).
- The ERC has also been revising its forecasts quarterly, using the first release of quarterly National Accounts (Mar, Jun, Sep, Dec) but further gains can be obtained using nowcasting and more timely information/data.
- Our current technology can also be easily adapted to nowcasting.
- In addition, new (**MIDAS**) models that take advantage of **the mixed data frequencies** of various variables such as financial or other variables are found to produce substantial gains in nowcasting.