

# Finance, Potential Output and the Business Cycle

## Evidence from Selected Advanced and CESEE Economies

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Conference on European Economic Integration (CEEI)  
Vienna, November 2013

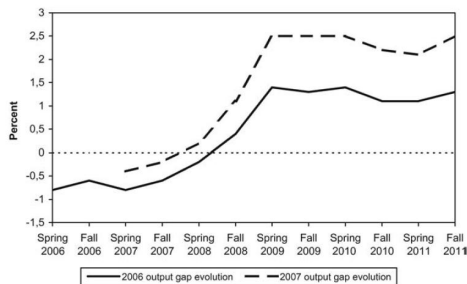
*This presentation is based on joint work with Dominik Bernhofer (OeNB), Octavio Fernández-Amador (University of Linz) and Friedrich Sindermann (University of Innsbruck). The views expressed in this presentation are exclusively those of the authors and do not necessarily reflect those of the OeNB or the Eurosystem.*

# The Finance-Growth Nexus and the Time Perspective

- Long-term view: Financial sector plays crucial role in the economy
    - Financial development fosters economic growth
    - Strong heterogeneity across countries
  - Short and medium-term view: Financial deepening might cause instability and crises
    - Strong credit growth predicts financial crises
    - Excessive credit growth in CESEE prior to crisis?
- **Challenge:** How to decompose overall impact into cyclical and structural (“sustainable”) developments?

# Business Cycle Measurement

- Stabilization policies
  - **Basic idea:** Minimize output gap
  - Estimates essential for efficient rule-based economic policy
  - Relevant for monetary, fiscal and macroprudential policy
- Example: Estimated pre-crisis output gap in the euro area



Source: *European Commission Forecasts in Orphanides & Wieland (2013)*

# Standard Models: The Concept of “Flexible-Price Output”

- A simple structural model ...
  - Aggregate Demand
  - Phillips Curve
  - Taylor Rule
- ... subject to the equilibrium condition ...
  - Inflation:  $\pi_t = \pi_{t-1} = \pi^T$
- ... yields *inflation-neutral* potential output.

→ Sustainable output defined as “nonaccelerating inflation output”

→ Core idea of standard (semi)structural approaches to measure potential output

# Financial Crisis Challenged Macroeconomic Consensus

- Pre-crisis boom phase characterized by low and stable inflation rates
  - Sustainability criterion of potential output gains importance
  - Current measurement of cyclical fluctuations and potential output ignores the cyclical effects of finance
- How to include the financial cycle into standard models?

# The Financial Cycle in Economics

- **Common understanding:** Selfenforcing but unstable circle between financing constraints, asset prices and economic activity
- Stylized features of the financial cycle (Borio 2013):
  - Described by co-movement of credit and property prices
  - Financial cycle frequency well below business cycle frequency
  - Real-time indicator for financial distress (crises)
  - Length and amplitude depend on policy regimes
- How to include finance into standard statistical filters?
  - Consideration of private credit and house prices
  - Following and extending pioneering work by Borio et al. (2013)
  - Nonstructural, purely data-driven (reduced-form) empirical framework
  - Country sample: IE, NL, AT, US / BG, EE, PL, SK

# Extending the Harvey and Jaeger (1993) Model

- State-Space Model: Decompose log real GDP into unobserved components

$$y_t = \mu_t + \psi_t + \varepsilon_t$$

where  $\mu_t$  is a trend,  $\psi_t$  is a cyclical and  $\varepsilon_t$  is an irregular component.

→ Approach nests HP filter as a special case (see appendix)

→ Define trend state (see appendix)

→ Define cyclical state: Embedding information on the **financial cycle**

$$\psi_t = \gamma_1 \text{CREDIT}_t + \gamma_2 \text{HOUSE}_t + \rho \cos \lambda_c \psi_{t-1} + \rho \sin \lambda_c \psi_{t-1}^* + \kappa_t$$

where CREDIT is (demeaned) real credit growth, and HOUSE is (demeaned) real house price growth.

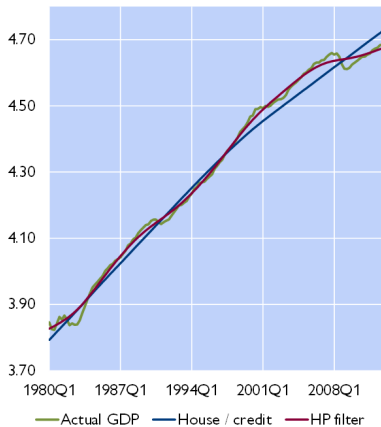
- Model yields measures of...
  - *finance-augmented* cyclical fluctuations and
  - corresponding measures of *finance-neutral* potential output.
- Benchmark models: Kalman (base) and HP filter

# Economic Intuition (I)

## EXAMPLE: United States (I)

### Actual GDP Level and Estimated Trend Output

GDP (index in logs)



Source: OeNB.

### Estimated Cyclical Components

in % of potential output



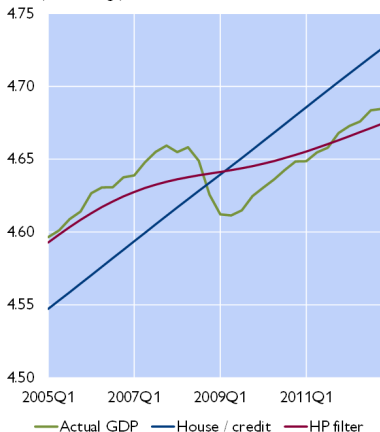


# Economic Intuition (II)

## EXAMPLE: United States (II)

### Actual GDP Level and Estimated Trend Output

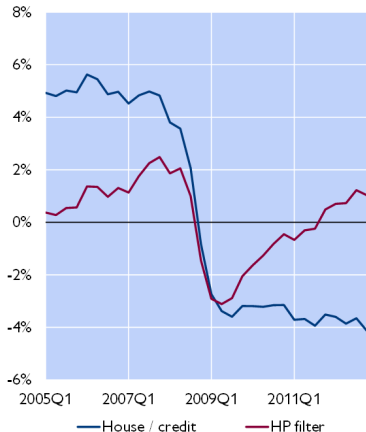
GDP (index in logs)



Source: OeNB.

### Estimated Cyclical Components

in % of potential output

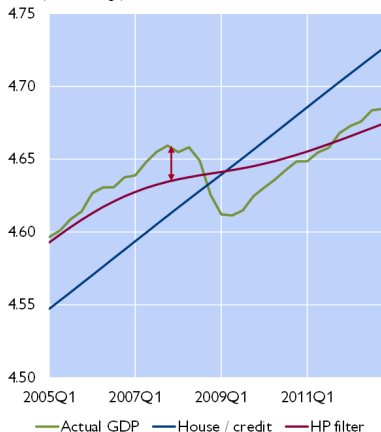


# Economic Intuition (II)

## EXAMPLE: United States (II)

### Actual GDP Level and Estimated Trend Output

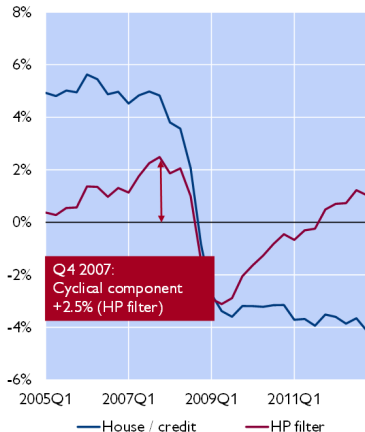
GDP (index in logs)



Source: OeNB.

### Estimated Cyclical Components

in % of potential output

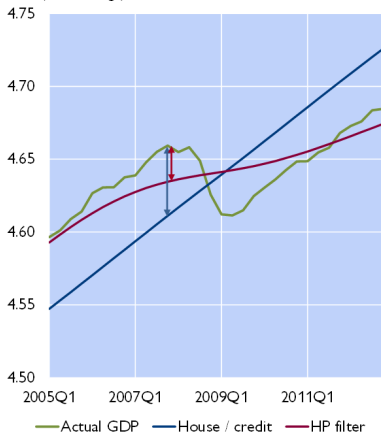


# Economic Intuition (II)

## EXAMPLE: United States (II)

### Actual GDP Level and Estimated Trend Output

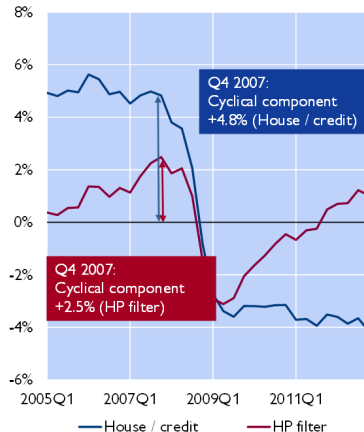
GDP (index in logs)



Source: OeNB.

### Estimated Cyclical Components

in % of potential output

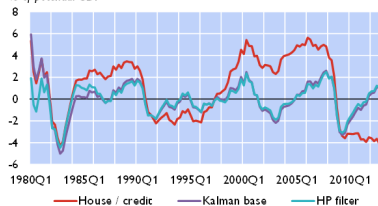


# Empirical Results (I): United States

## UNITED STATES

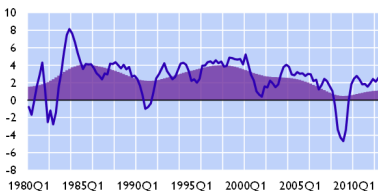
### Cyclical Components of GDP

% of potential GDP



### GDP Growth Decomposition: HP Filter

Growth rate in %



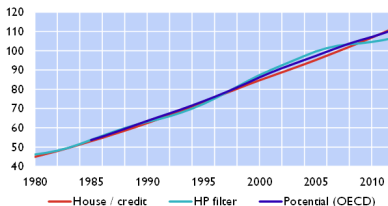
Source: OeNB.

— Trend HP filter

— Real GDP

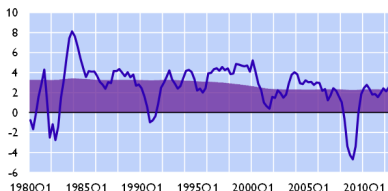
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: Kalman Filter House / Credit

Growth rate in %



— Trend house / credit

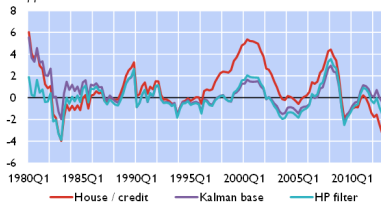
— Real GDP

# Empirical Results (III): Netherlands

## NETHERLANDS

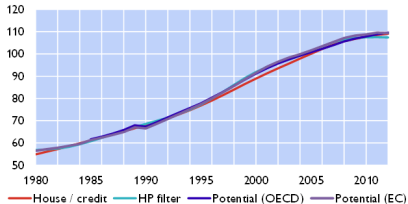
### Cyclical Components of GDP

% of potential GDP



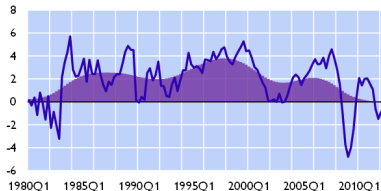
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: HP Filter

Growth rate in %

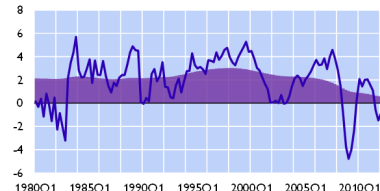


Source: OeNB.

— Trend HP filter

### GDP Growth Decomposition: Kalman Filter House / Credit

Growth rate in %



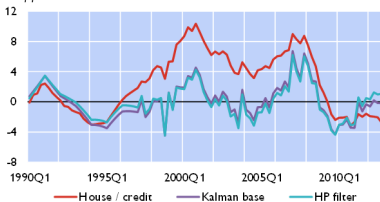
— Trend house / credit

# Empirical Results (III): Ireland

## IRELAND

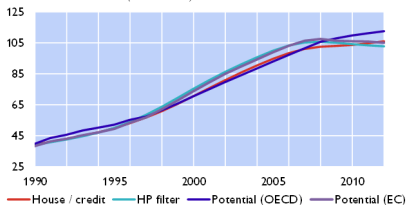
### Cyclical Components of GDP

% of potential GDP



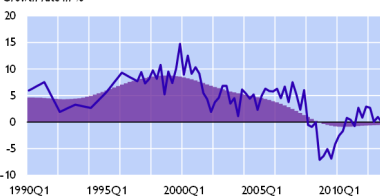
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: HP Filter

Growth rate in %



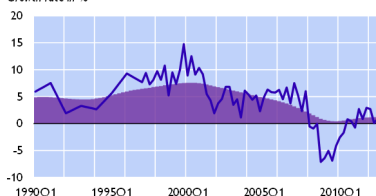
Source: OeNB.

Trend HP filter

Real GDP

### GDP Growth Decomposition: Kalman Filter House / Credit

Growth rate in %



Trend house / credit

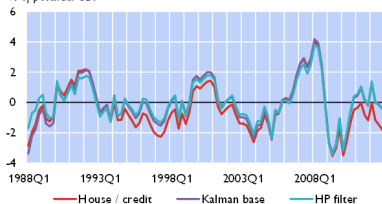
Real GDP

# Empirical Results (IV): Austria

## AUSTRIA

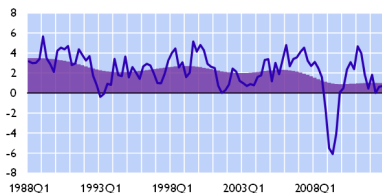
### Cyclical Components of GDP

% of potential GDP



### GDP Growth Decomposition: HP Filter

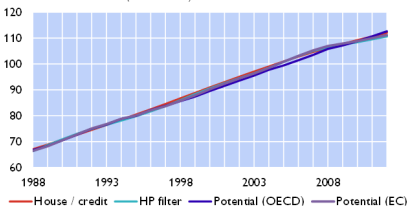
Growth rate in %



Source: OeNB.

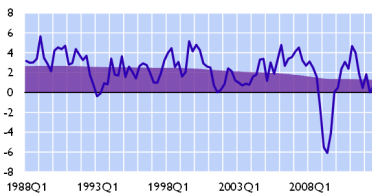
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: Kalman Filter House / Credit

Growth rate in %

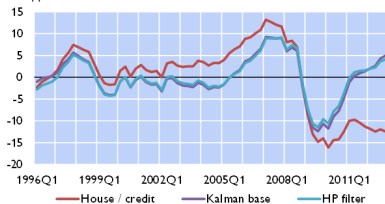


# Empirical Results (V): Estonia

## ESTONIA

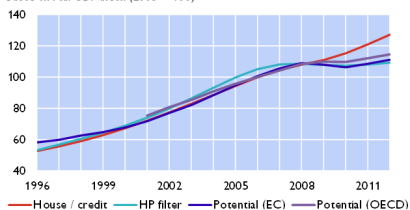
### Cyclical Components of GDP

% of potential GDP



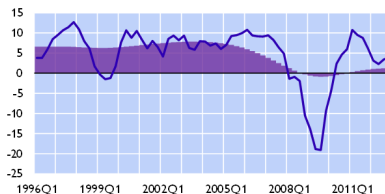
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: HP Filter

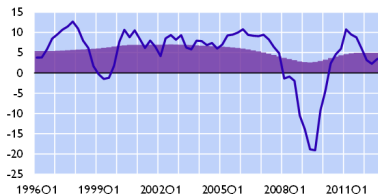
Growth rate in %



Source: OeNB.

### GDP Growth Decomposition: Kalman Filter House / Credit

Growth rate in %



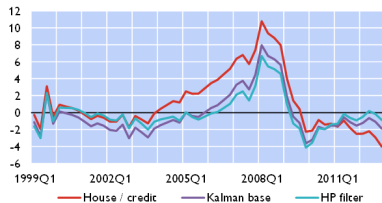


# Empirical Results (VI): Bulgaria

## BULGARIA

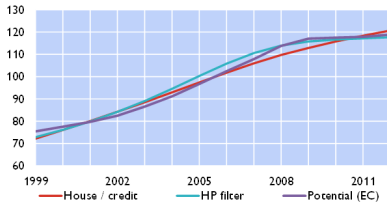
### Cyclical Components of GDP

% of potential GDP



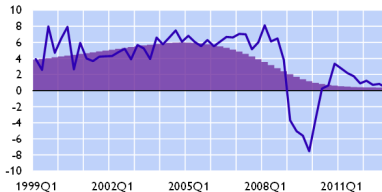
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: HP Filter

Growth rate in %



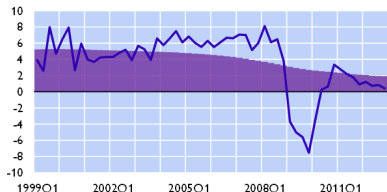
Source: OeNB.

Trend HP filter

Real GDP

### GDP Growth Decomposition: Kalman Filter House / Credit

Growth rate in %



Trend house / credit

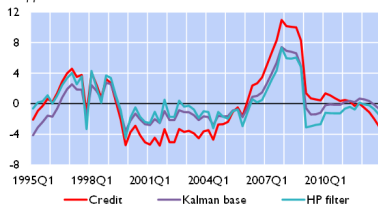
Real GDP

# Empirical Results (VII): Slovakia

## SLOVAKIA

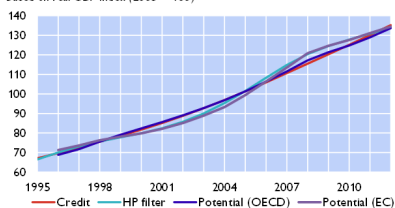
### Cyclical Components of GDP

% of potential GDP



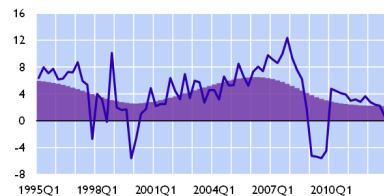
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: HP Filter

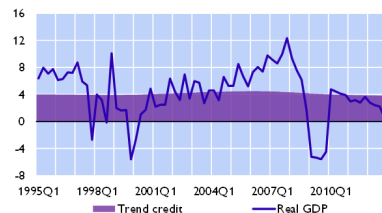
Growth rate in %



Source: OeNB. — Trend HP filter

### GDP Growth Decomposition: Kalman Filter Credit

Growth rate in %



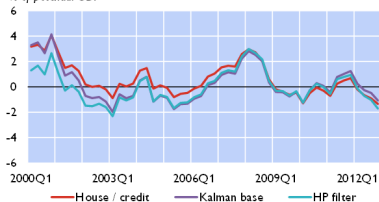
— Trend credit

# Empirical Results (VIII): Poland

## POLAND

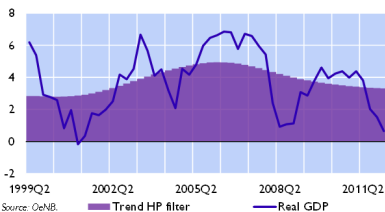
### Cyclical Components of GDP

% of potential GDP



### GDP Growth Decomposition: HP Filter

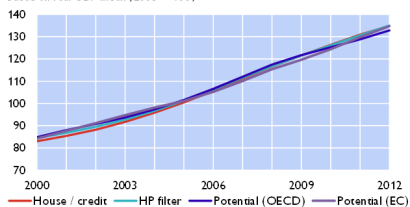
Growth rate in %



Source: OeNB.

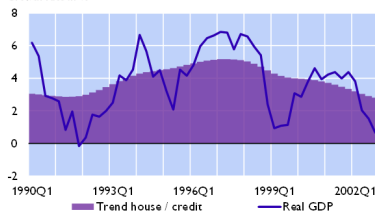
### Potential / Trend GDP

based on real GDP Index (2005 = 100)



### GDP Growth Decomposition: Kalman Filter House / Credit

Growth rate in %



## Interpretation and Discussion

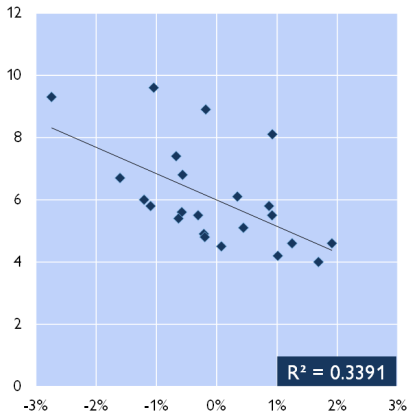
- Interpretation of results crucially depends on the concept of potential output
  - No structural or theoretical foundation
  - Purely data-driven statistical filter
  - Transmission channels from the financial sector to the real economy cannot be analyzed within this framework
- **But:** Is our model able to replicate some standard propositions of structural models?
  - How do our estimates of finance-augmented output gaps correspond to actual unemployment rates?
  - Plausibility check

# The Financial Cycle and Unemployment (I)

## UNITED STATES: Cyclical Deviations and Unemployment Rates (1990-2012)

### HP Filter

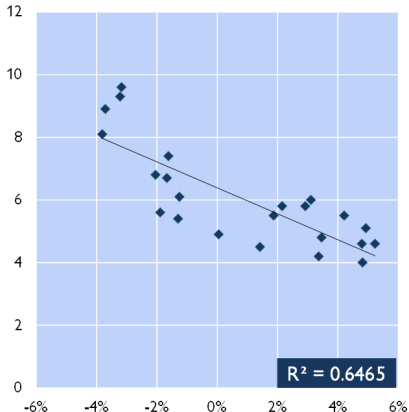
Unemployment rate in %



Source: OeNB. Cyclical component in % of potential GDP

### Kalman Filter House / Credit

Unemployment rate in %



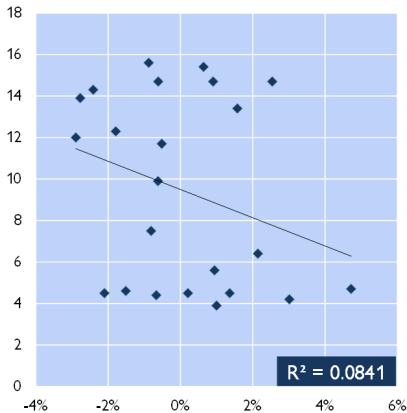
Cyclical component in % of potential GDP

# The Financial Cycle and Unemployment (II)

## IRELAND: Cyclical Deviations and Unemployment Rates (1990-2012)

### HP Filter

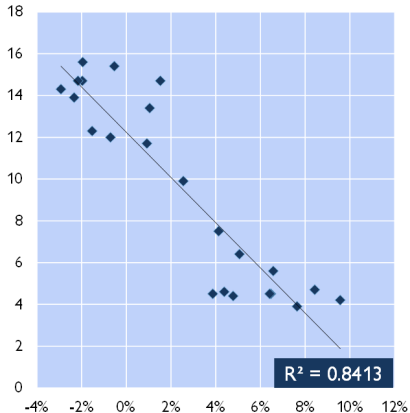
Unemployment rate in %



Source: OeNB. Cyclical component in % of potential GDP

### Kalman Filter House / Credit

Unemployment rate in %



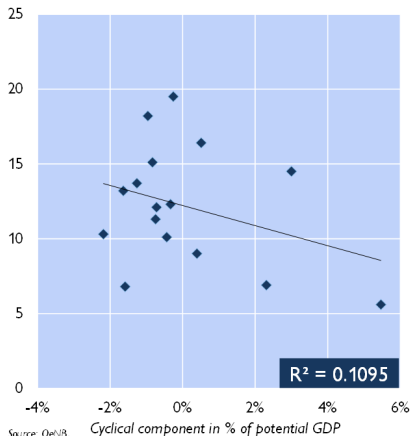
Cyclical component in % of potential GDP

# The Financial Cycle and Unemployment (III)

## BULGARIA: Cyclical Deviations and Unemployment Rates (1997-2012)

### HP Filter

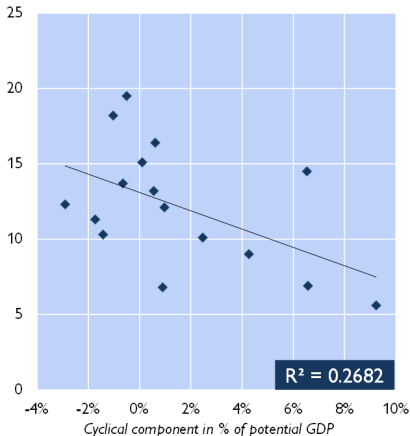
Unemployment rate in %



Source: OeNB.

### Kalman Filter House / Credit

Unemployment rate in %

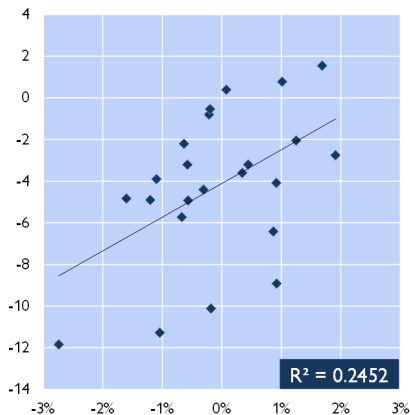


# The Financial Cycle and Public Deficits (I)

## UNITED STATES: Cyclical Deviations and General Government Net Lending / Borrowing (1990-2012)

### HP Filter

Government net lending / borrowing (% of GDP)

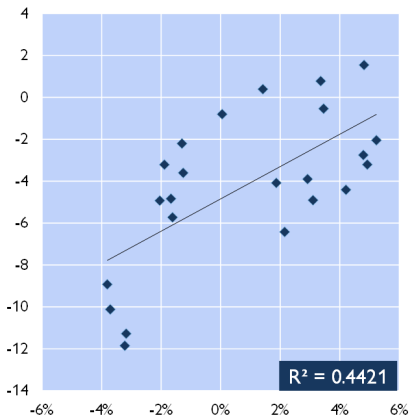


Source: OeNB.

Cyclical component in % of potential GDP

### Kalman Filter House / Credit

Government net lending / borrowing (% of GDP)



Cyclical component in % of potential GDP

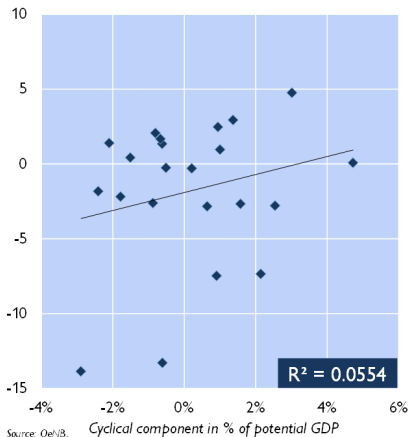


# The Financial Cycle and Public Deficits (II)

## IRELAND: Cyclical Deviations and General Government Net Lending / Borrowing (1990-2012, excl. 2010)

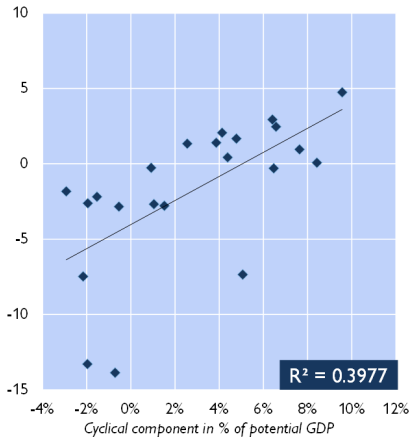
### HP Filter

Government net lending / borrowing (% of GDP)



### Kalman Filter House / Credit

Government net lending / borrowing (% of GDP)

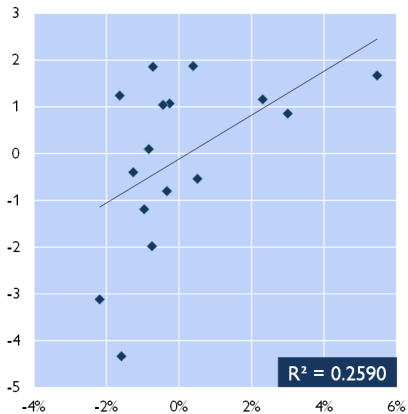


# The Financial Cycle and Public Deficits (III)

## BULGARIA: Cyclical Deviations and General Government Net Lending / Borrowing (1997-2012)

### HP Filter

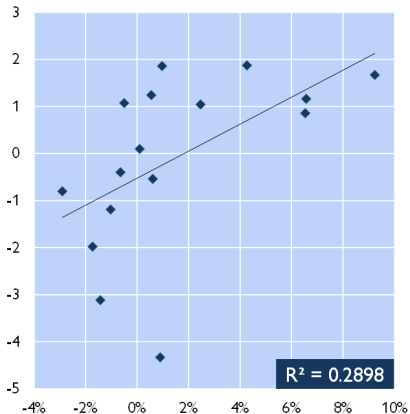
Government net lending / borrowing (% of GDP)



Source: OeNB. Cyclical component in % of potential GDP

### Kalman Filter House / Credit

Government net lending / borrowing (% of GDP)



Cyclical component in % of potential GDP

## Some General Conclusions

- *Finance-augmented* cyclical components show considerable deviations from standard estimates
  - Approach indicates unsustainable developments despite low and stable inflation rates in boom phases, and
  - Enhances our understanding of cyclical vs. structural adjustments in bust/recession phases
- Avenues for future research
  - Include further variables into cyclical state equation
  - Nonlinearities and asymmetries
  - Real-time robustness of estimates

## Appendix and Additional Material

- Data sources
- Harvey and Jaeger (1993) model and extensions
- Descriptive statistics / raw time series
  - Real GDP
  - House prices
  - Private credit

## Data Sources

- Country sample:
  - Four advanced economies: IE, NL, AT, US
    - Quarterly data (mostly) since early 1980s
  - Four CESEE economies: BG, EE, PL, SK
    - Quarterly data (mostly) since mid-1990s
- Credit data:
  - Bank for International Settlements (BIS) Database: total credit to private nonfinancial sector (Dembiermont et al. 2013)
  - International Financial Statistics (IFS): domestic banks' claims on resident nonbank sector (excluding state and local governments)
- House price data:
  - Nonharmonized country data from national sources
  - ECB, BIS and OeNB (for CESEE countries compiled from national sources; see Hildebrandt et al. 2012, Huynh-Olesen et al. 2013)

## State-Space Model Approach by Harvey and Jaeger (1993)

Decompose log real GDP into unobserved components:

$$y_t = \mu_t + \psi_t + \varepsilon_t, \quad \varepsilon_t \sim \text{NID}(0, \sigma_\varepsilon^2), t = 1, \dots, T \quad (1)$$

where  $\mu_t$  is a trend,  $\psi_t$  is a cyclical and  $\varepsilon_t$  is an irregular component.

Define trend state:

$$\mu_t = \mu_{t-1} + \beta_{t-1} \quad (2)$$

$$\beta_t = \beta_{t-1} + \zeta_t, \quad \zeta_t \sim \text{NID}(0, \sigma_\zeta^2) \quad (3)$$

Define cyclical state:

$$\psi_t = \rho \cos \lambda_c \psi_{t-1} + \rho \sin \lambda_c \psi_{t-1}^* + \kappa_t, \text{ where } \kappa_t \sim \text{NID}(0, \sigma_\kappa^2), 0 \leq \rho \leq 1 \quad (4)$$

$$\psi_t^* = -\rho \sin \lambda_c \psi_{t-1} + \rho \cos \lambda_c \psi_{t-1}^* + \kappa_t^*, \quad \kappa_t^* \sim \text{NID}(0, \sigma_\kappa^2) \quad (5)$$

→ Approach nests HP filter as a special case where  $\psi_t = 0$  and  $\sigma_\varepsilon^2 / \sigma_\zeta^2 = \lambda = 1600$

# Extending the Harvey & Jaeger (1993) Model

How to embed information about the *financial cycle* into the cyclical component?

Extension of equation (4):

$$\psi_t = \gamma_1 CREDIT_t + \gamma_2 HOUSE_t + \rho \cos \lambda_c \psi_{t-1} + \rho \sin \lambda_c \psi_{t-1}^* + \kappa_t \quad (6)$$

where *CREDIT* is (demeaned) real credit growth and *HOUSE* is (demeaned) real house price growth.

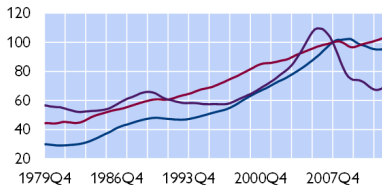
- Five different models:
  - (1) HP filter
  - (2) Kalman base
  - (3) Kalman including CREDIT
  - (4) Kalman including HOUSE
  - (5) Kalman including CREDIT & HOUSE
- Models (3) to (5) yield different measures of...
  - *finance-augmented* cyclical fluctuations and
  - corresponding measures of *finance-neutral* potential output.

# Used Variables (I): Advanced Economies

## Advanced Economies

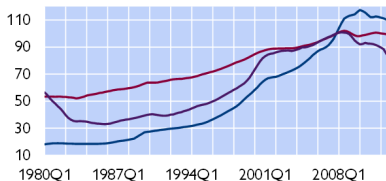
### UNITED STATES

Index 2007Q4=100



### NETHERLANDS

Index 2007Q4=100

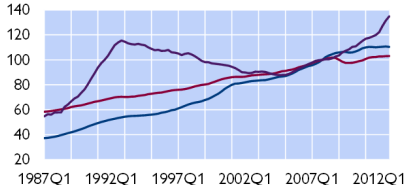


Source: BIS, IMF, OeNB.

— Real credit — Real GDP — Real house prices

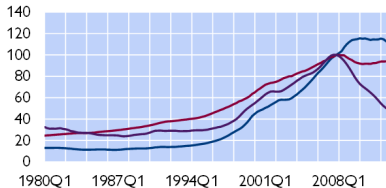
### AUSTRIA

Index 2007Q4=100



### IRELAND

Index 2007Q4=100



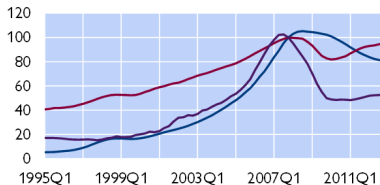


# Used Variables (II): CESEE Economies

## Economies in CESEE

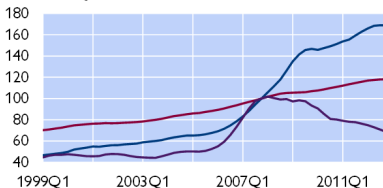
### ESTONIA

Index 2007Q4=100



### POLAND

Index 2007Q4=100

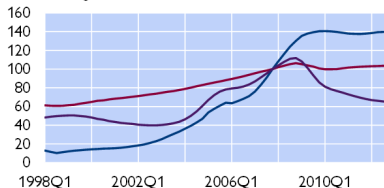


Source: BIS, IMF, OeNB.

— Real credit — Real GDP — Real house prices

### BULGARIA

Index 2007Q4=100



### SLOVAKIA

Index 2007Q4=100

