LIECHTENSTEIN-INSTITUT

April 17th 2019, ETH Zürich

*Composite Index **KonSens**: Coincident, Sub-Annual Business Cycle Sensor for Liechtenstein's Economy*

Andreas Brunhart

KOF RESEARCH SEMINAR

Schedule for Today's Presentation

[1] Introduction:

- Distinction growth/business cycle
- Short description of KonSens project
- Prologue: Closer look at Liechtenstein's economy

[2] Motivation for KonSens:

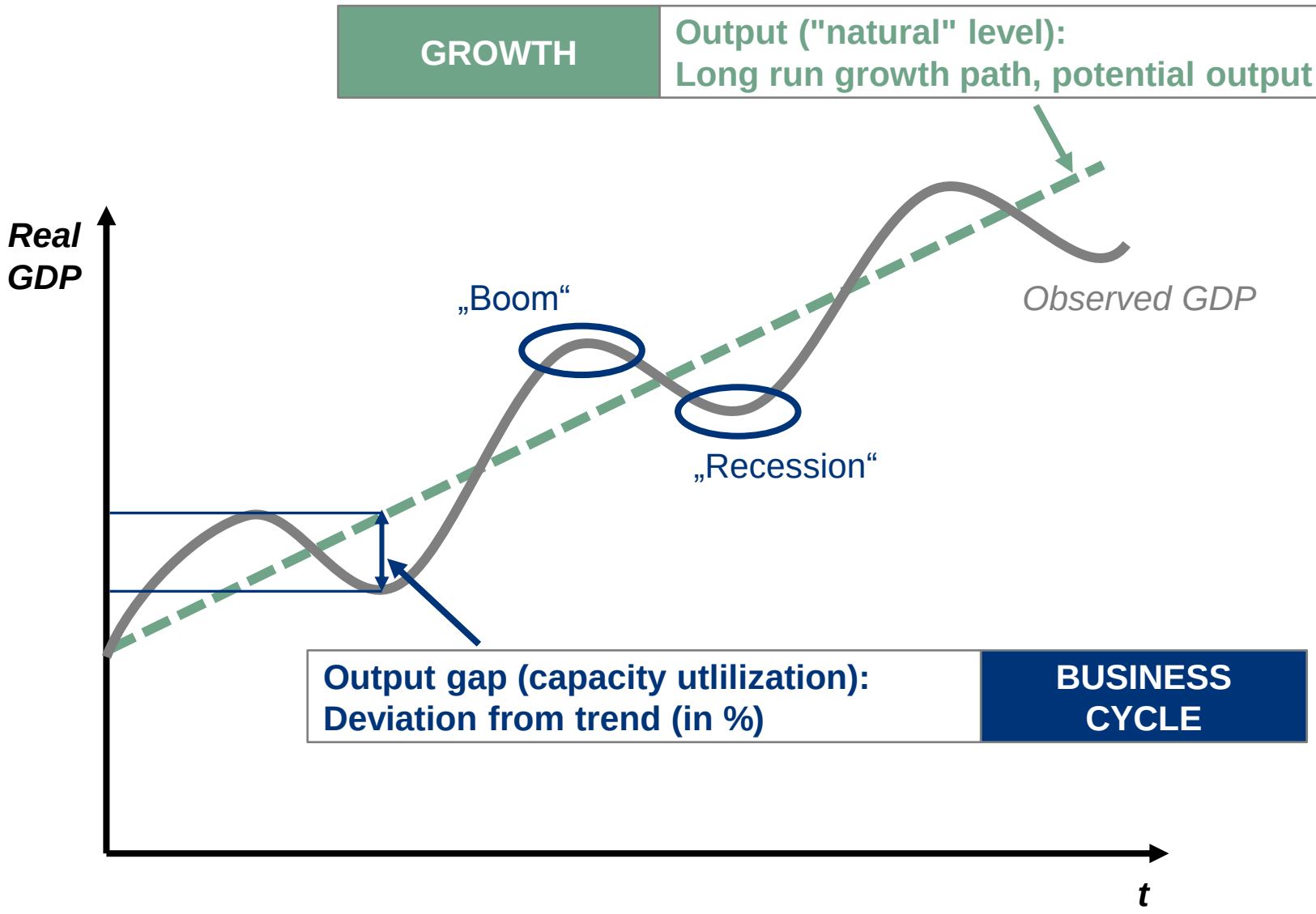
- Status quo in Liechtenstein: Data situation/business cycle analysis
- Explicit and implicit benefits of KonSens

[3] Compilation **method** of KonSens: Included indicators and applied time serial methods

[4] Current **KonSens plot**

[5] Conclusions: Summary and outlook

Distinction between Growth and Business Cycle



KonSens: Short Description

- **Quarterly, coincident composite indicator** for Liechtenstein's business cycle consisting of **16** individual economic indicators
- Goal of KonSens: **Focus on state** of Liechtenstein's business cycle, **not on determinants**/influences
- Name „KonSens“:
  - Conception of **„Business Cycle as a Consensus“** (BURNS AND MITCHELL [1946]) of various individual business cycle impulses
  - „KonSens“ is also an abbreviation for **„Konjunktur-Sensor“**: Sensorium of Liechtenstein's business cycle situation
- First publication (in August 2019): KonSens for **2nd Quarter 2019** (most likely: www.liechtenstein-institut.li/konsens)
- Other composite indicators: *KOF Barometer* (leading ind., ABBERGER ET AL. [2018]), *SNB Business Cycle Index* (early ind., GALLI [2018]), *CFNAI* (coincident ind.), [*Konjunkturbarometer Ostschweiz*, *ifo-Geschäftsklimaindex*], [*Bodenseeklimaindex*/*CS-Barometer*]

Prologue: Closer Look on Liechtenstein's Economy

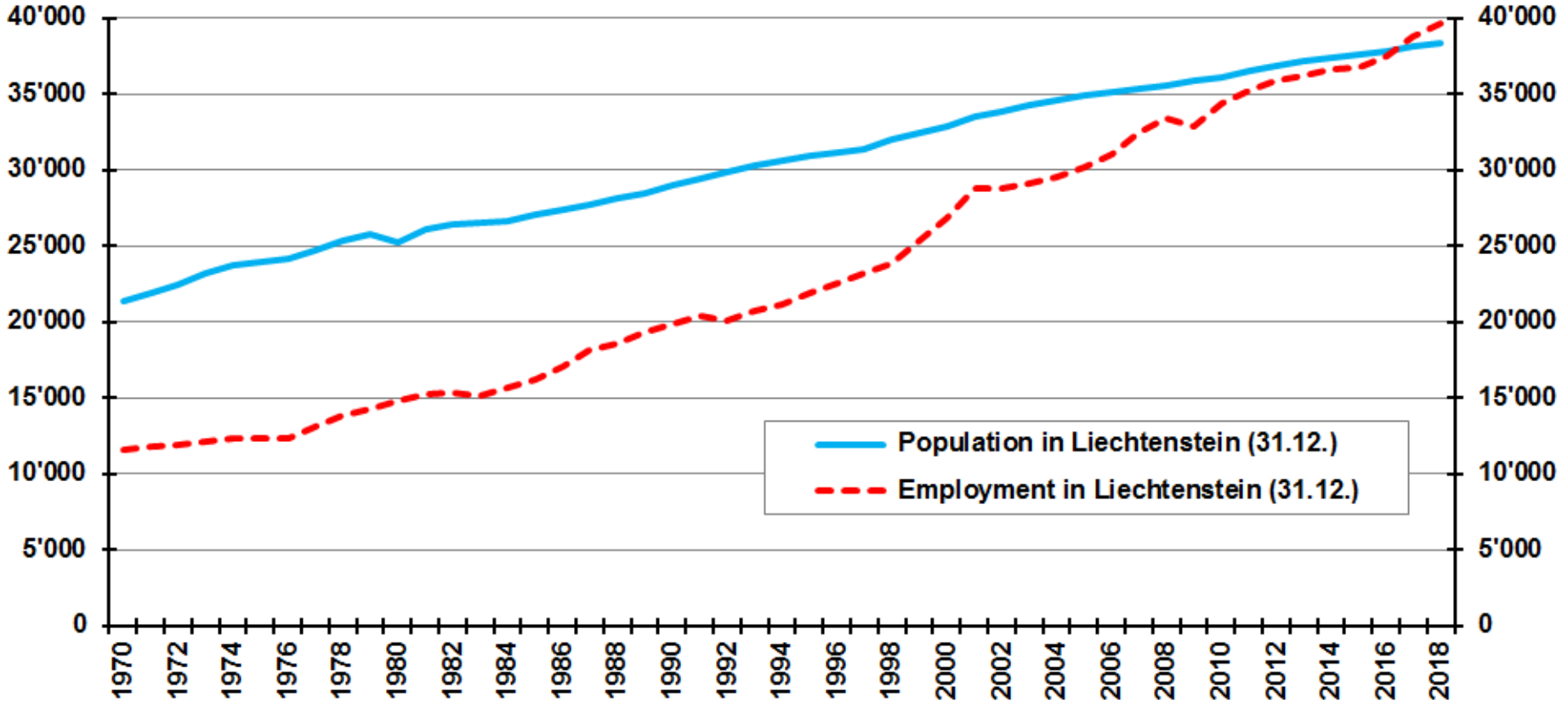
- Some key facts on Liechtenstein:
  - Population/employment:
    - **38'380 inhabitants** (2018, around 34% foreign population)
    - **39'660 employed people** (2018), inward commuter share of more than 55%. Unemployment rate 1.7% (324 people, 2018 average).
  - Economic/sectoral structure:
    - By end of 2016, 17 largest companies employed 12'695 people (about 33% of total work force). But about 88% of the 4'567 companies have fever than 10 employees (1 company per 8 inhabitants).

Employed persons (2016)	Agriculture	Industry and manufacturing	General services	Financial services
Liechtenstein	0.7%	37.9%	45.0%	16.4%
Switzerland	3.2%	21.1%	69.4%	6.4%
Austria	4.4%	25.6%	70.1%	
Germany	1.4%	24.2%	74.4%	
Luxembourg	0.9%	18.9%	62.9%	17.2%

Data source: OSL (Employment Statistics), FSO (Job Statistics, Employment Statistics), STATEC.

Source: BRUNHART AND FROMMELT [2018]

Prologue: Closer Look on Liechtenstein's Economy



Prologue: Closer Look on Liechtenstein's Economy

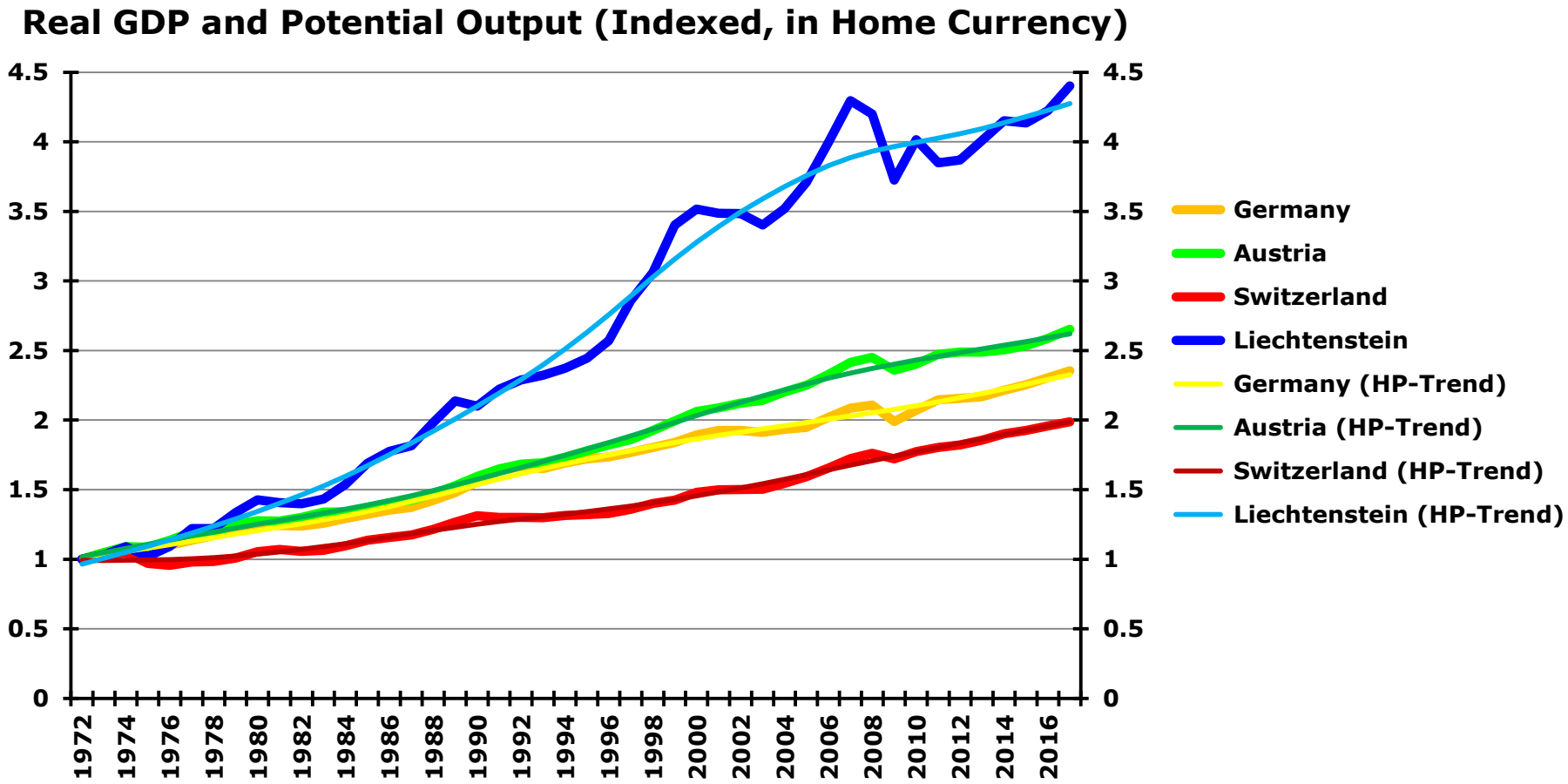
- Some key facts on Liechtenstein:
  - Gross value added (2016): Industry/manufacturing 43%, general services 27%, financial services 23%, (agriculture/households 7%)
  - International comparison:

2016	Liechtenstein	Switzerland	Austria	Germany	Luxembourg
Gross domestic product (CHF billion)	6.1	659	385	3,427	58
Population (31 Dec)	37,810	8,419,550	8,722,865	82,521,653	590,667
Employees (annual average)	37,104	4,899,550	4,220,300	43,638,000	418,400
Full-time equivalents (annual average)	31,861	3,829,823			
GDP/capita (population)	162,364	78,268	44,148	41,529	97,814
Productivity (GDP/employees)	165,454	134,498	91,248	78,534	138,086
Productivity (GDP/FTE)	192,681	172,065			

GDP is a measure of the income of persons resident in Liechtenstein and abroad, generated by work or assets in Liechtenstein (domestic principle), i.e. for domestic production whose value added is generated and accrued by persons resident in Liechtenstein and/or abroad.
Data source for GDP, population, employment, exchange rates: OSL (GDP Estimate, Statistical Yearbook), FSO (National Accounts, Employment Statistics), SNB, Statistik Austria, Destatis, STATEC, Eurostat. See Brunhart (2015), Von Stokar et al. (2016), and Kellermann and Schlag (2016) on Liechtenstein's productivity development.

Source: BRUNHART AND FROMMELT [2018]

Prologue: Closer Look on Liechtenstein's Economy



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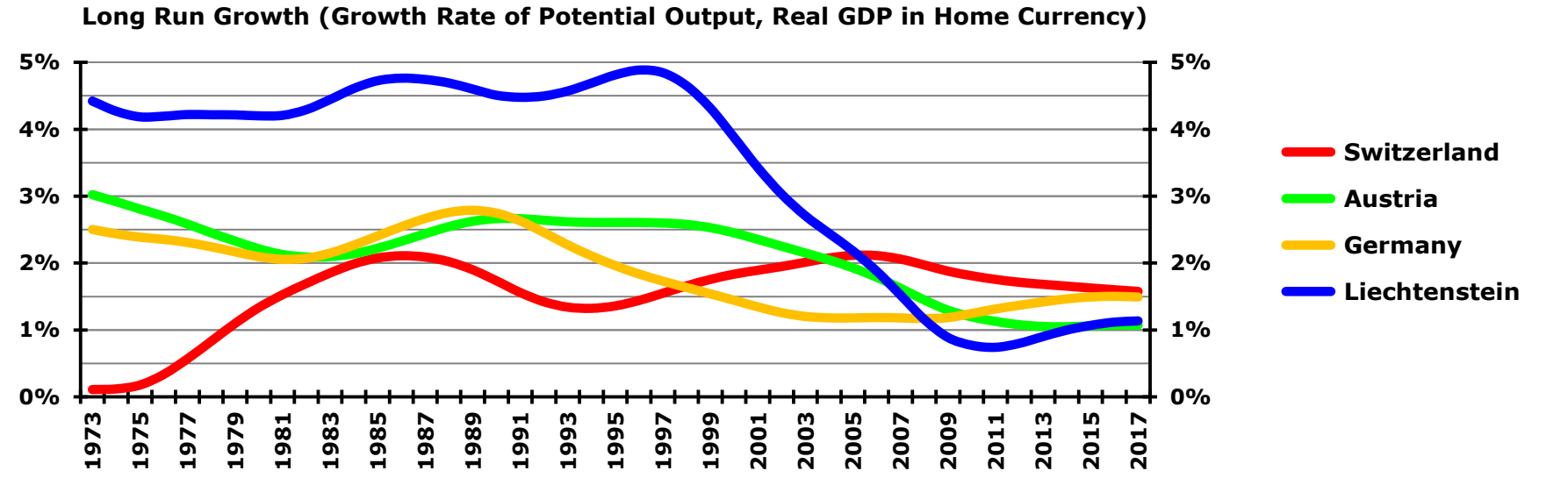
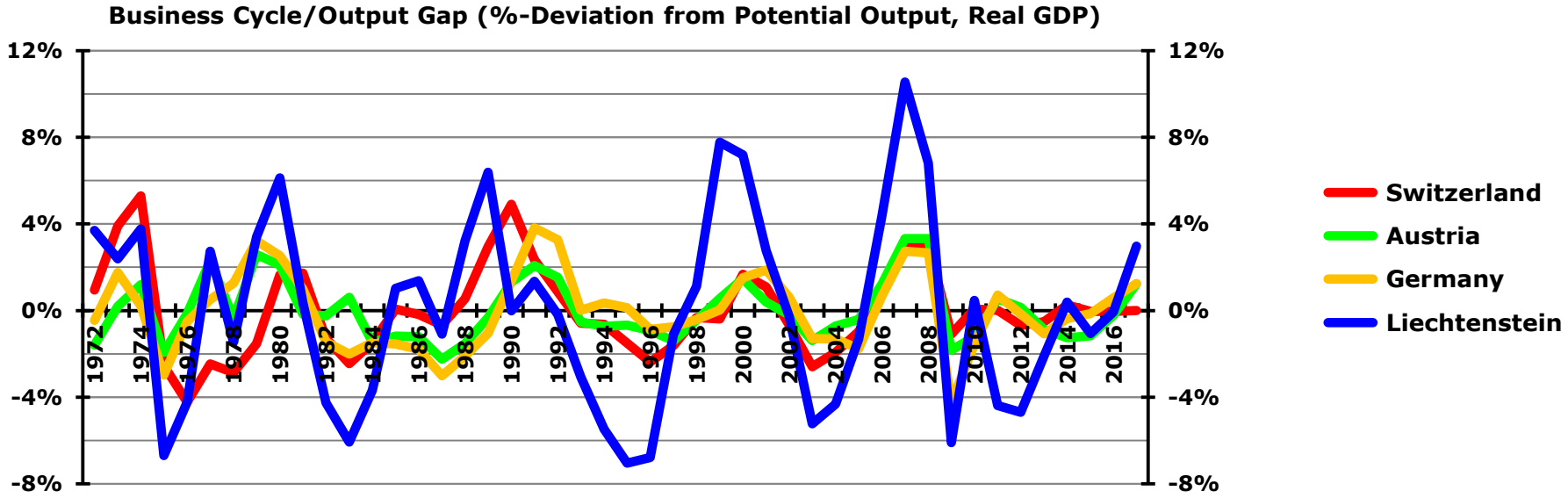
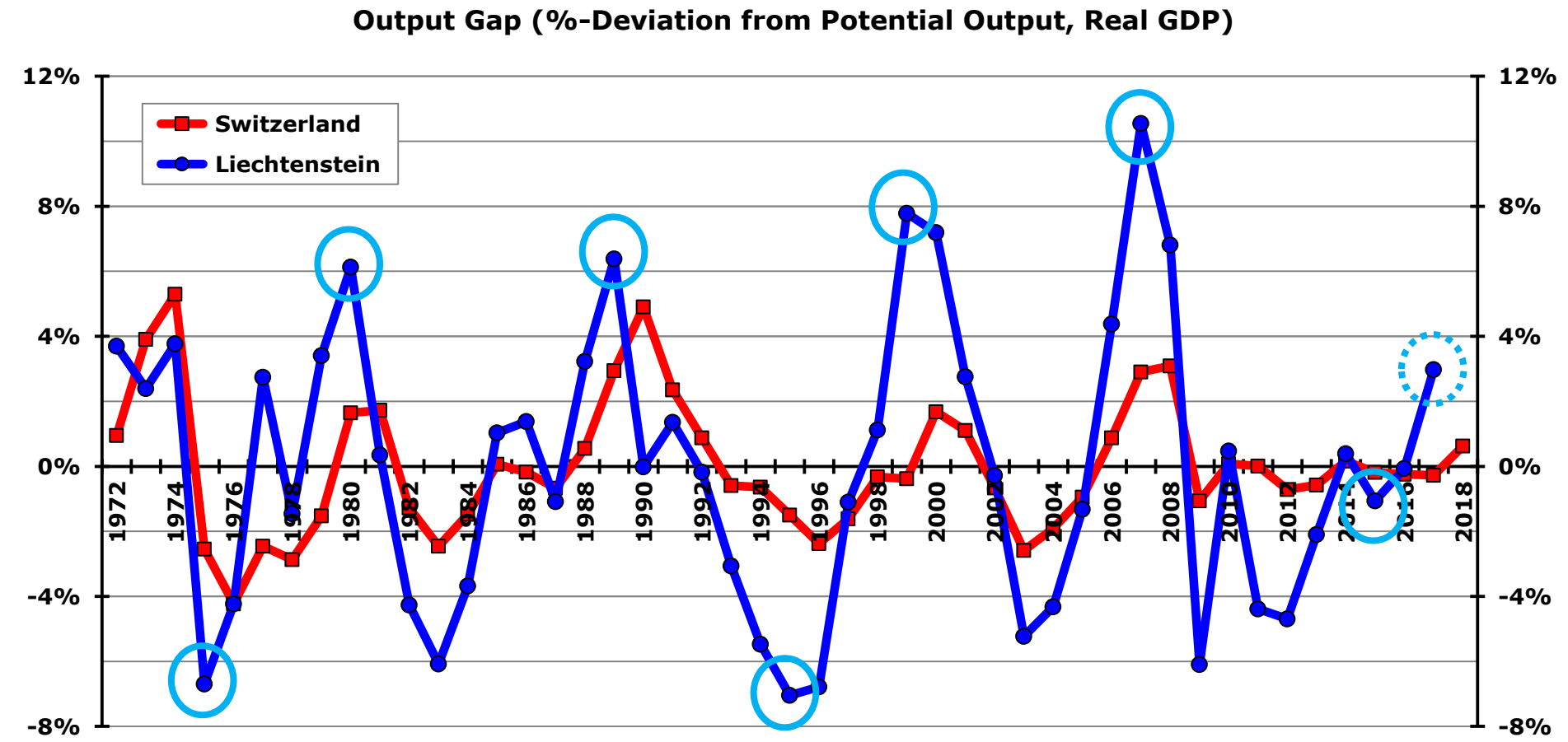




Prologue: Closer Look on Liechtenstein's Economy



Prologue: Closer Look on Liechtenstein's Economy

- Some of the stylized business cycle facts on Liechtenstein:
  - Amplitude:
    - **Volatility very high** (growth rates, output gap) in international comparison
    - High volatility **not very surprising** for such a small country (see EASTERLY AND KRAAY [2000] or other literature on small state economics)
  - Timing:
    - Rather **leading** than lagging business cycle properties
    - Liechtenstein's **lead might be contra-intuitive** and in contrast to traditional notion of small countries as "business cycle importers". But, if small states are more sensitively affected by international business cycle shocks, why not earlier?

! Both stylized facts mentioned above make timely **business cycle analysis** (KonSens etc.) in Liechtenstein **even more important**

KonSens: Status Quo

- Liechtenstein's current economic data situation:
  - GDP only **annually available**, **long publication lag** (15 months)
  - **Scarce data base** (especially sub-annual): No seperate balance of payments, no price indexes etc. But: Some **useful indicators** available!

- **Leading propiertes** of **Liechtenstein's** business cycle, particularly to **Switzerland** (BRUNHART [2017]): Focus on and extension of **domestic data base important,** rather than only observing foreign indicators/data!

➲ **Initial funding** of KonSens by **Liechtenstein's government**. Future development of business cycle and growth monitoring tools dependent on future funding of Liechtenstein Institute in general **(parliament decision, autumn 2019)**

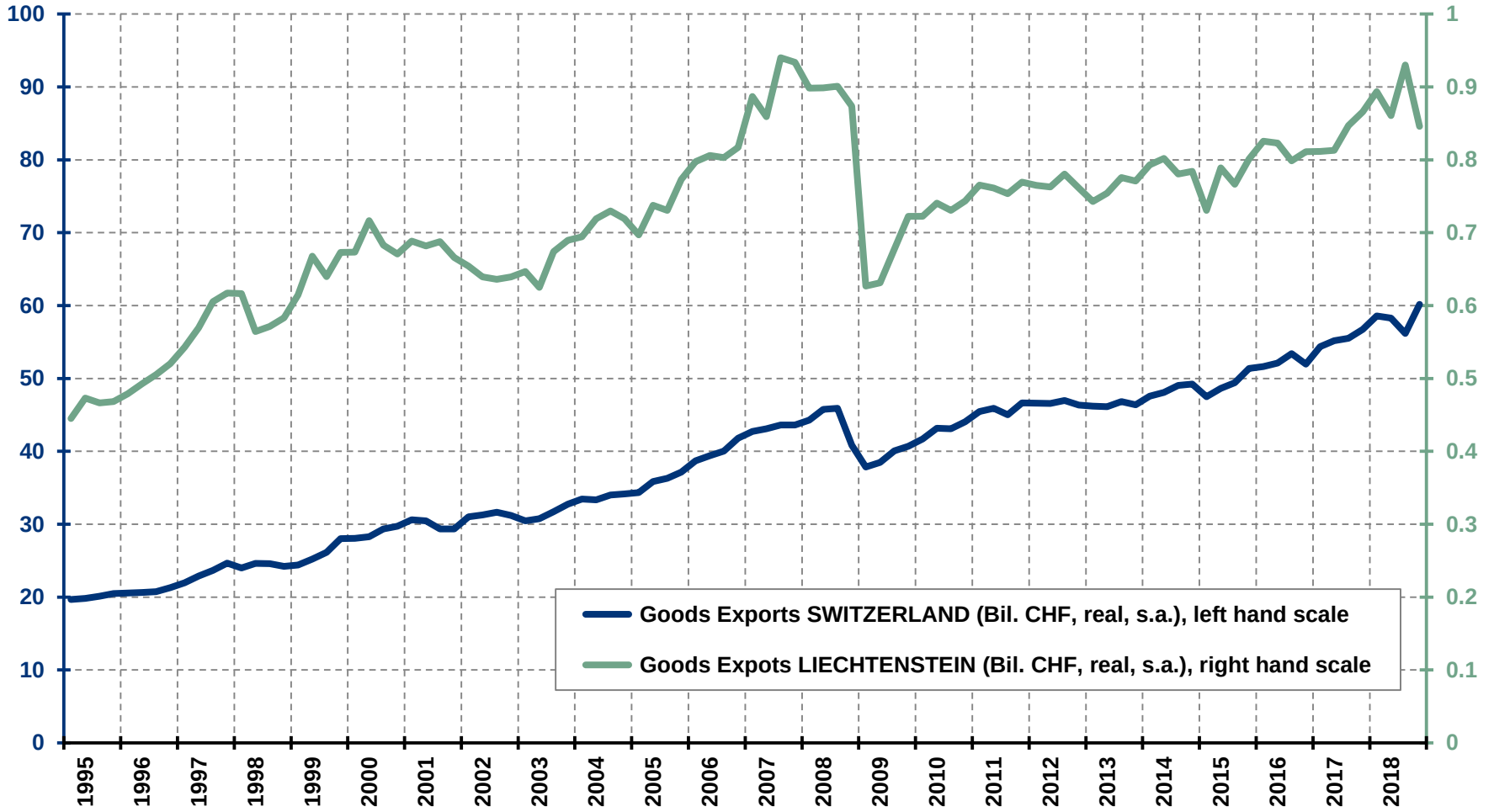
KonSens: Explicit Benefits

- Timely gathering of **various** – sometimes contradicting – **business cycle signals** to a **consistent picture** (publication lag: around **6 weeks)**
- **Easy interpretation** for politics, public administration, media, companies and general public
- Fills the some of the gap after **KOFL closure**
- **Reduces reliance on Swiss data**/indicators (which is not always efficient for reasons already discussed)
- Combines **different data origins and dimensions**
- **Improves data base** for economic analyses: Publication of KonSens and applied/modified time series to public, synergies to other planned tools planned at Liechtenstein Institute

KonSens: Implicit Benefits

- Good **effort/benefit** ratio of KonSens project!
- Useful variable for **nowcasting annual and/or estimating quarterly figures** for Liechtenstein's **GDP**
- Better **reporting, monitoring** and **surveillance** (e.g. Finanzmarktaufsicht Liechtenstein, Standard & Poor's)
- Could **influence other small states, regions or even cities (with scarce data base)** to introduce similar tools ➔ under such circumstances, **already coincident signal** can be big **progress** (before even thinking about prediction…)!
- KonSens could be useful **predicting Swiss business cycle**

KonSens: Indirect Benefits (Predicting CH Cycle)



KonSens: Indirect Benefits (Predicting CH Cycle)

VAR 1995Q1–2018Q4 (N=91)	Dependent Variable			
	[1a]	[1b]	[2a]	[2b]
	$\Delta\log[EXPS_t]$	$\Delta\log[EXPL_t]$	$\Delta\log[EXPS_t]$	$\Delta\log[EXPL_t]$
Intercept	0.0185***	0.0015	0.0220***	0.0090*
$\Delta\log[EXPS_{t-1}]$	-0.0497	1.1059***	-0.1776	0.3933**
$\Delta\log[EXPS_{t-2}]$	-0.4198***	0.1430	-0.3161***	0.2121
$\Delta\log[EXPS_{t-3}]$	-0.2625*	-0.1490	-0.2082*	-0.0119
$\Delta\log[EXPS_{t-4}]$	-0.3673**	-0.2136	-0.3034***	-0.1687
$\Delta\log[EXPL_{t-1}]$	0.1255*	-0.3422***	0.1326***	-0.2512***
$\Delta\log[EXPL_{t-2}]$	0.1777**	-0.0708	0.1425***	-0.0711
$\Delta\log[EXPL_{t-3}]$	0.2091***	-0.1289	0.1679***	0.0500
$\Delta\log[EXPL_{t-4}]$	0.1230*	-0.0342	0.0977**	0.0009
Time Dummy 08Q4			-0.1173***	-0.0526
Time Dummy 09Q1			-0.0999***	-0.3023***
Goodness-of-Fit Measures				
R^2	0.1858	0.2902	0.4824	0.5690
Adjusted R^2	0.1064	0.2210	0.4177	0.5151
AIC	-4.4064	-3.2587	-4.8155	-3.7135

$EXPS_t$: Goods Exports Switzerland (real quarterly figures, seasonally adjusted); $EXPL_t$: Goods Exports Liechtenstein (real quarterly figures, seasonally adjusted).
The relevant p-values are indicated by asterisks (*: p-value ≤ 0.10 and > 0.05; **: p-value ≤ 0.05 and > 0.01; ***: p-value ≤ 0.01). The p-values are obtained applying a t-distribution (and a degree of freedom adjustment of the standard error).

KonSens: Indirect Benefits (Predicting CH Cycle)

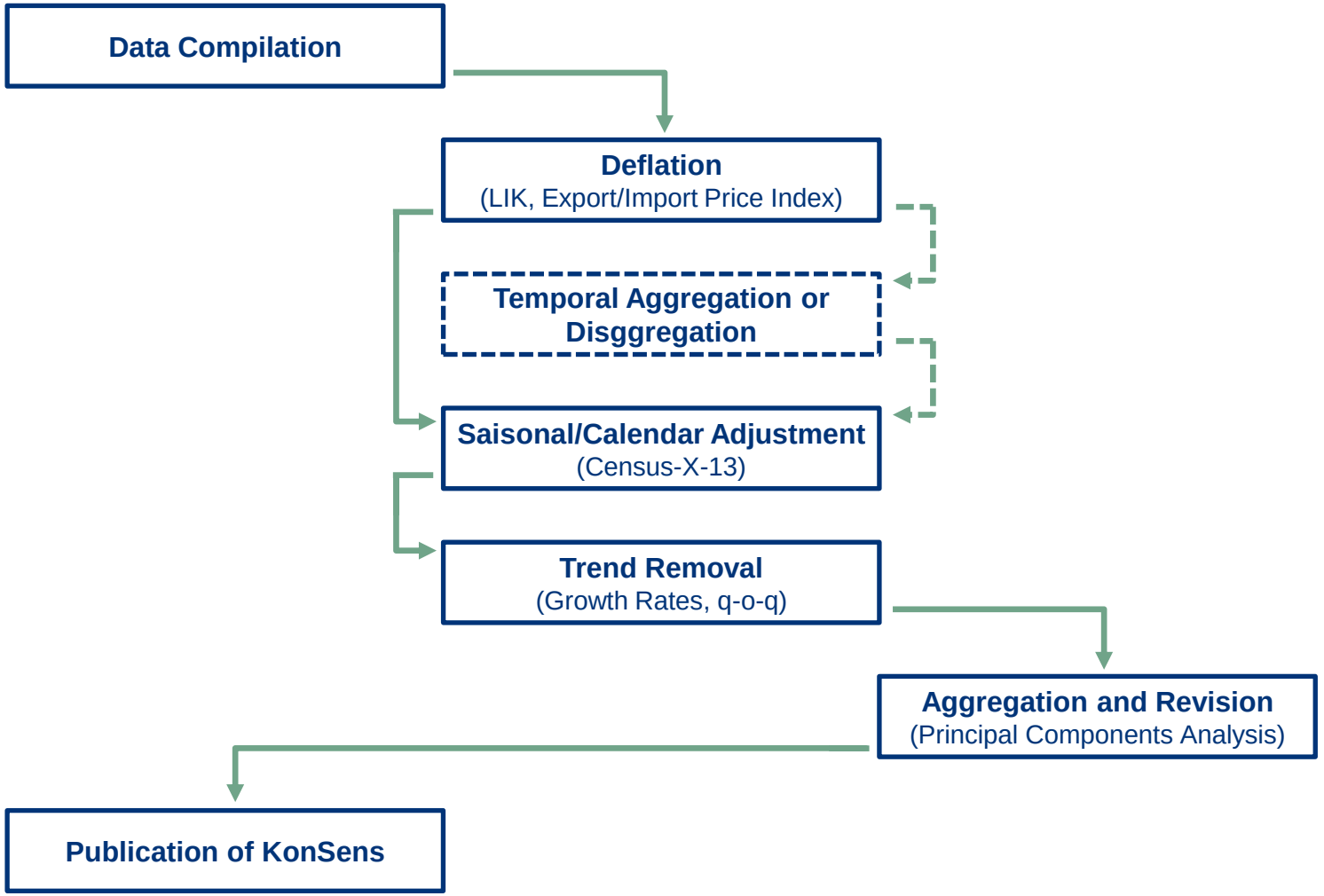
Variables (Granger-Tests)	VAR-Length	Sample	Frequency	Leads (P-Value)
dlog[*GDPL*] ➔ dlog[*GDPS*]	BRUNHART [2017]: Strong and robust GDP lead of 1 year			
dlog[*GVAIL*] ➔ dlog[*GVAIS*]	BRUNHART [2017]: Gross value added (industrial sector) seems to have lead of 1 year			
dlog[*EXPL*] ➔ dlog[*EXPS*]	12	1995–2018	Monthly	5 (p=0.08), 8 (p=0.03), 10 (p=0.05)
	4	1995–2018	Quarterly	1 (p=0.07), 2 (p=0.02), 3 (p=0.01), 4 (p=0.07)
dlog[*EXPL*] ➔ dlog[*GDPS*]	4	1995–2018	Quarterly	3 (p=0.01)
d[*KONSENS*] ➔ dlog[*EXPS*]	4	1998–2018	Quarterly	1 (p=0.05)
d[*KONSENS*] ➔ dlog[*GDPS*]	4	1998–2018	Quarterly	1 (p=0.11)

All data are real figures and seasonally adjusted, except for monthly export figures (nominal, seasonally adjusted).
Lead also appears for nominal and seasonally unadjusted data.

KonSens: 16 Included Indicators

- Goods **trade**:
  - *Direct goods exports*, *direct goods imports* (CH not included, EZV)
- **Employment** data:
  - *Employed people*, *inward commuters* (full time equivalents, AS)
  - *Unemployed persons* (AMS/AS)
  - *Job openings* (AMS)
- **Business survey** (43 companies in metal/non-metal/construction, ca. 70% of employment in industry/manufacturing sector):
  - *Overall situation*, *capazity utilization*, *new orders*, *earnings* (indexed, AS)
- **Other** Indicators:
  - *Stock prices* LLB/VPB (SIX)
  - *Electric power consumption* (kWh, LKW)
  - *Newly registered cars* (AS)
  - *Overnight stays* (AS)
  - *Consumer sentiment* CH/A (SECO/Eur. Com.), *consumer prices* (LIK, BfS)

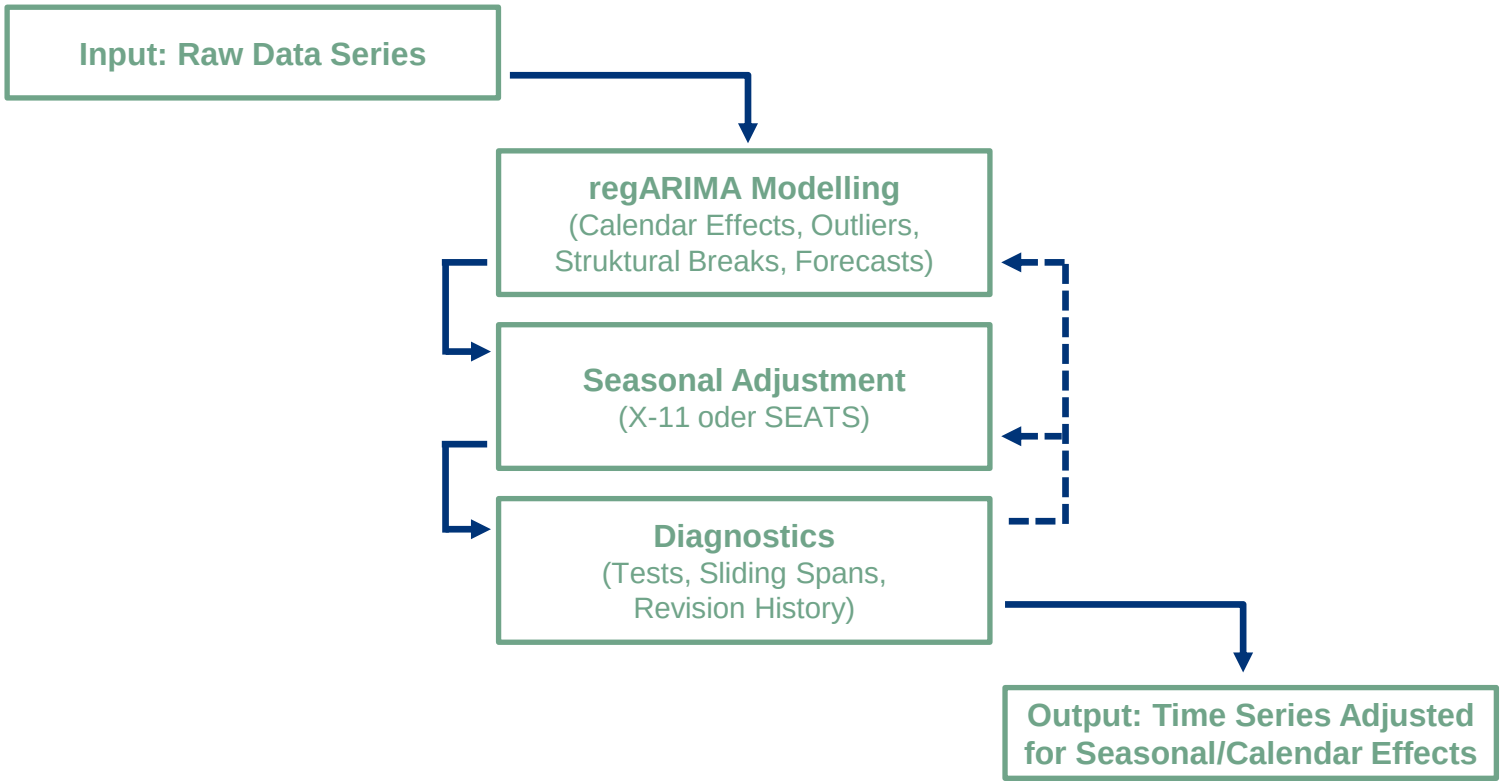
KonSens: Applied Time Serial Procedures



- Software applied ("4-eyes-principle"): EViews, Excel, JDemetra+, R

Time Serial Procedures: Seasonal Adjustment

- Census X-13:



Time Serial Procedures: Aggregation

- Principal Components Analysis (PCA):
  - Aim: **Reduction of data dimension** by aggregation to a value that serves as proxy for business cycle tendency
  - Methodical/formal aspects:
    - PCA gathers KonSens' 16 individual indicators X_j via 16 **uncorrelated linear combinations** (principal components H_i) with weights $a_{i,j}$:

$$H_1 = a_{1,1} \cdot X_1 + a_{1,2} \cdot X_2 + \cdots + a_{1,16} \cdot X_{16}$$

$$H_2 = a_{2,1} \cdot X_1 + a_{2,2} \cdot X_2 + \cdots + a_{2,16} \cdot X_{16}$$

$$\vdots \qquad\qquad \vdots$$

$$H_{16} = a_{16,1} \cdot X_1 + a_{16,2} \cdot X_2 + \cdots + a_{16,16} \cdot X_{16}$$

    - **First PC** (principal component) H_1 captures **largest proportion** of **variation in data**, second PC accounts for largest proportion of remaining variance, …
    - Squared weights $a_{i,j}$ build the **eigenvectors matrix** (loadings) and sum up to 1, for all 16 rows and columns

Time Serial Procedures: Aggregation

- Principal Components Analysis (PCA):
  - Aim: **Reduction of the data dimension** by aggregation to a value that serves as proxy for the business cycle tendency
  - Methodical/formal aspects:
    - Now, the **eigenvectors (weights) and the eigenvalues** of each PC have to be derived. Eigenvalues λ_i can be computed from the covariance matrix CM by solving $|CM - \lambda I| = 0$.

$$CM = \begin{bmatrix} \mathrm{cov}(X_1, X_1) & \mathrm{cov}(X_1, X_2) & \cdots & \mathrm{cov}(X_1, X_{16}) \\ \mathrm{cov}(X_2, X_1) & \mathrm{cov}(X_2, X_2) & \cdots & \mathrm{cov}(X_2, X_{16}) \\ \vdots & \vdots & \ddots & \vdots \\ \mathrm{cov}(X_{16}, X_1) & \mathrm{cov}(X_{16}, X_2) & \cdots & \mathrm{cov}(X_{16}, X_{16}) \end{bmatrix}$$

I: Unit matrix with same dimension as CM (KonSens: 16×16)

λ: Vector with all the eigenvalues of each PC (KonSens: 1×16)

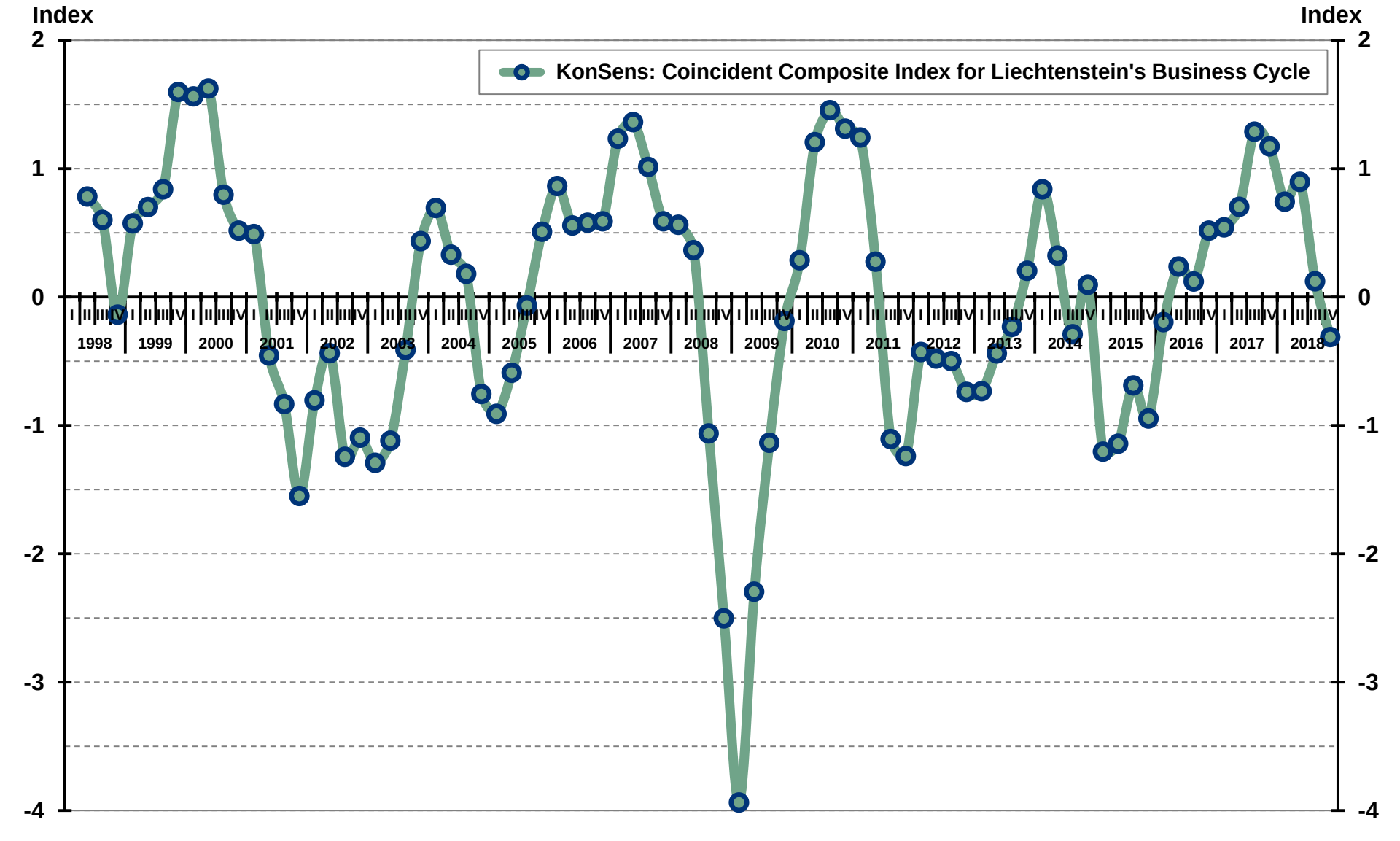
    - Eigenvalue of PC is the PC's variance. Sum of all 16 eigenvalues is equal to sum of diagonal covariances and equal to number of data series.

Time Serial Procedures: Aggregation

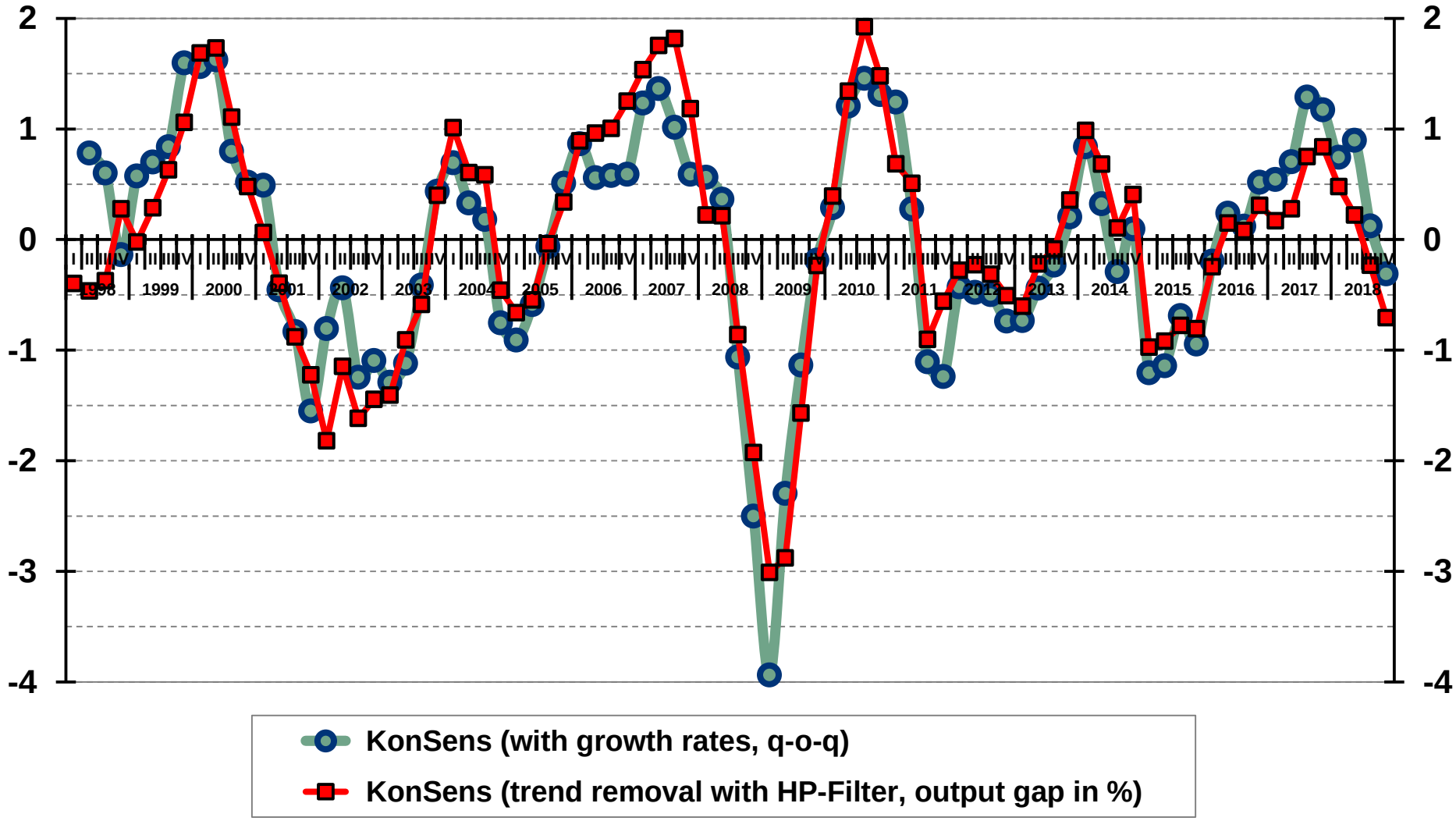
- Principal Components Analysis (PCA):
  - Interpretation:
    - Conception: The first PC (principal component) captures the most important common direction of the data (➔ **business cycle fluctuations**)

      ➔ Weighted sum in first PC (H_1): Business cycle signal (**KonSens**)
    - **Magnitude** of value somewhat **arbitrary**, only limited direct quantitative interpretation. But: **Relative comparison over time** possible!
    - Standardizing scores (mean 0, stand. dev. 1): Negative/positive value interpreted as **business activity** below/above **average** over time.
    - Eigenvalue of first PC allows judgement about **to which extent** the total data **variation can be attributed to business cycle** influence.
  - PCA **related to factor models**, common/latent factors (and their factor loadings) comparable to principal components (eigenvector matrix). PCA/factor models yield **similar results** (see STOCK AND WATSON [2002]), but originate from whole different statistical approaches.

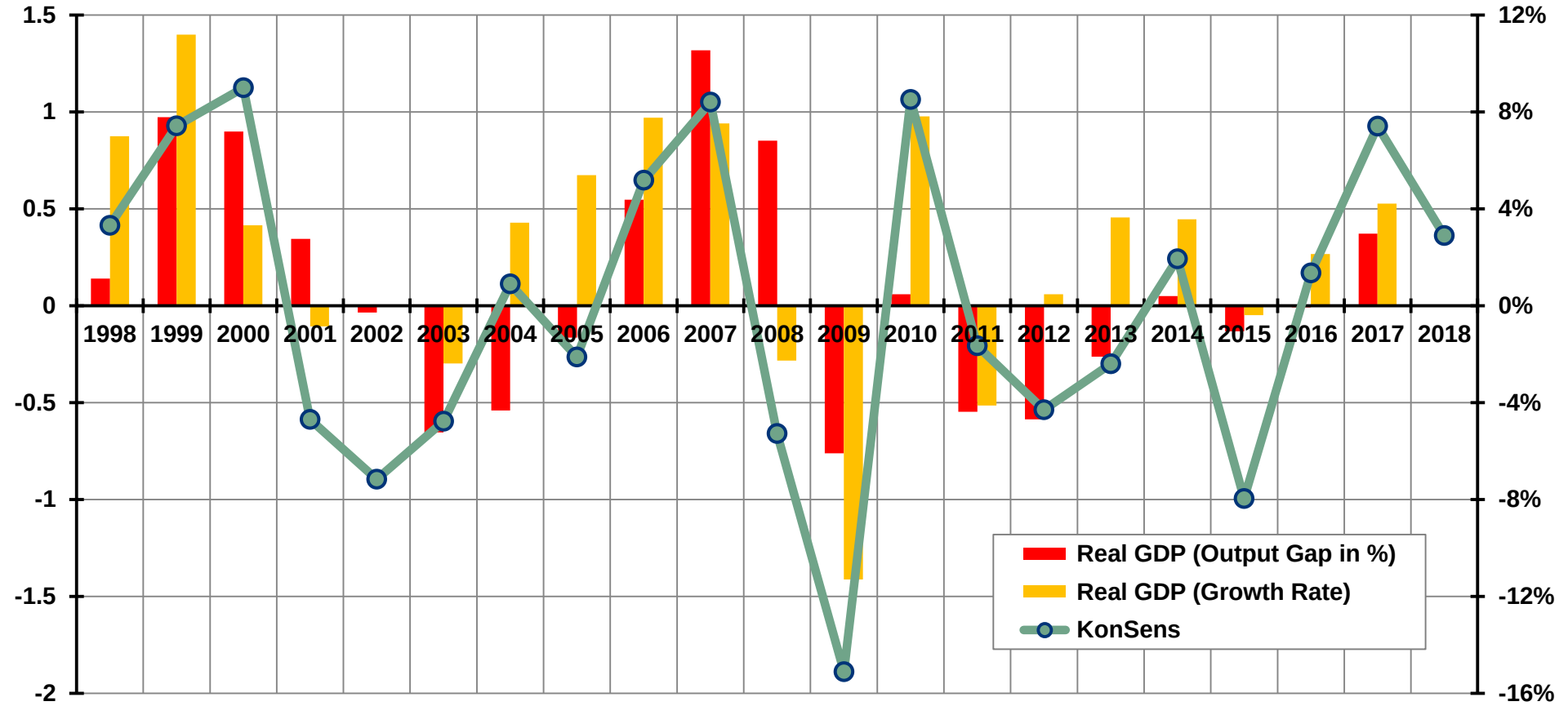
KonSens: Latest Plot



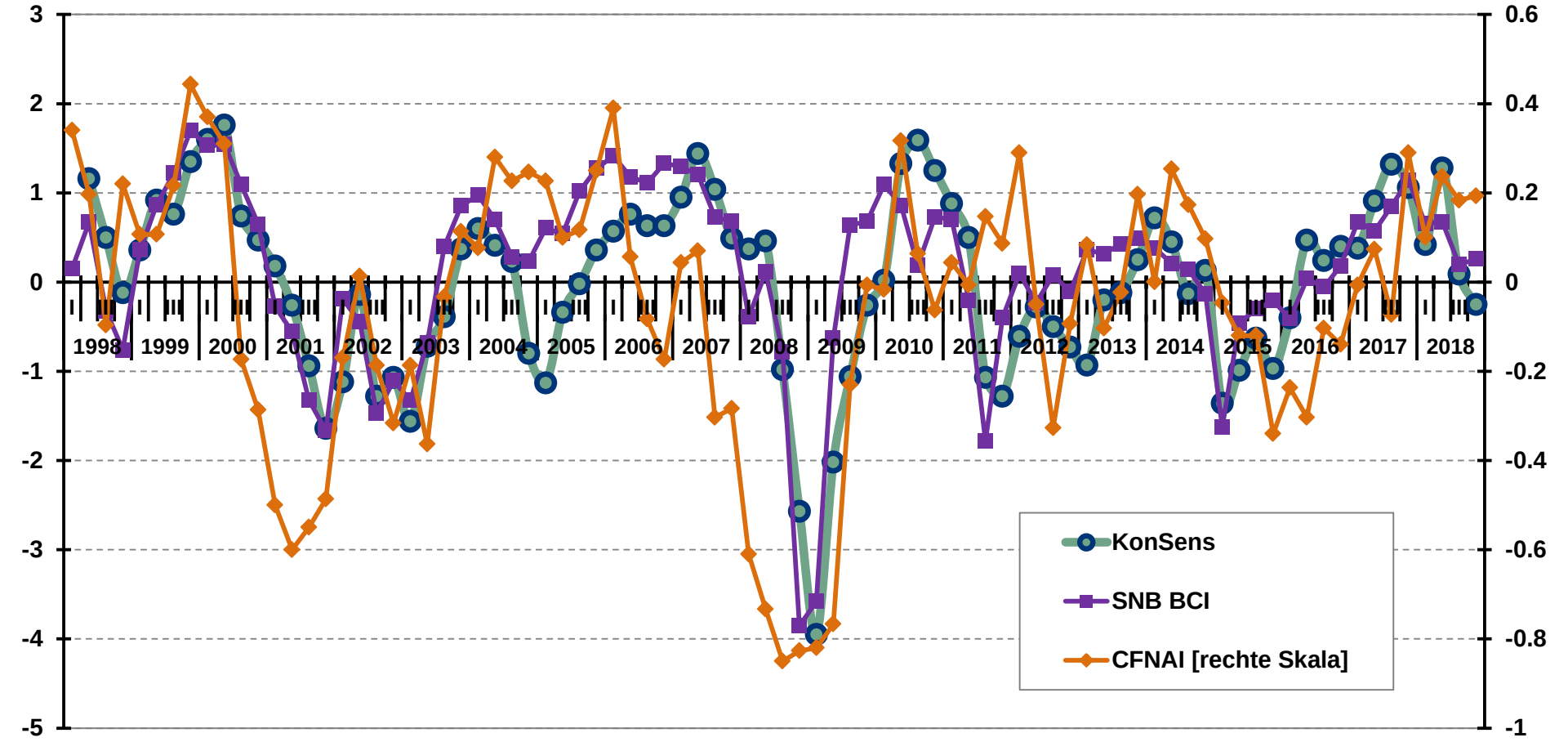
KonSens: Different Trend Removal Methods



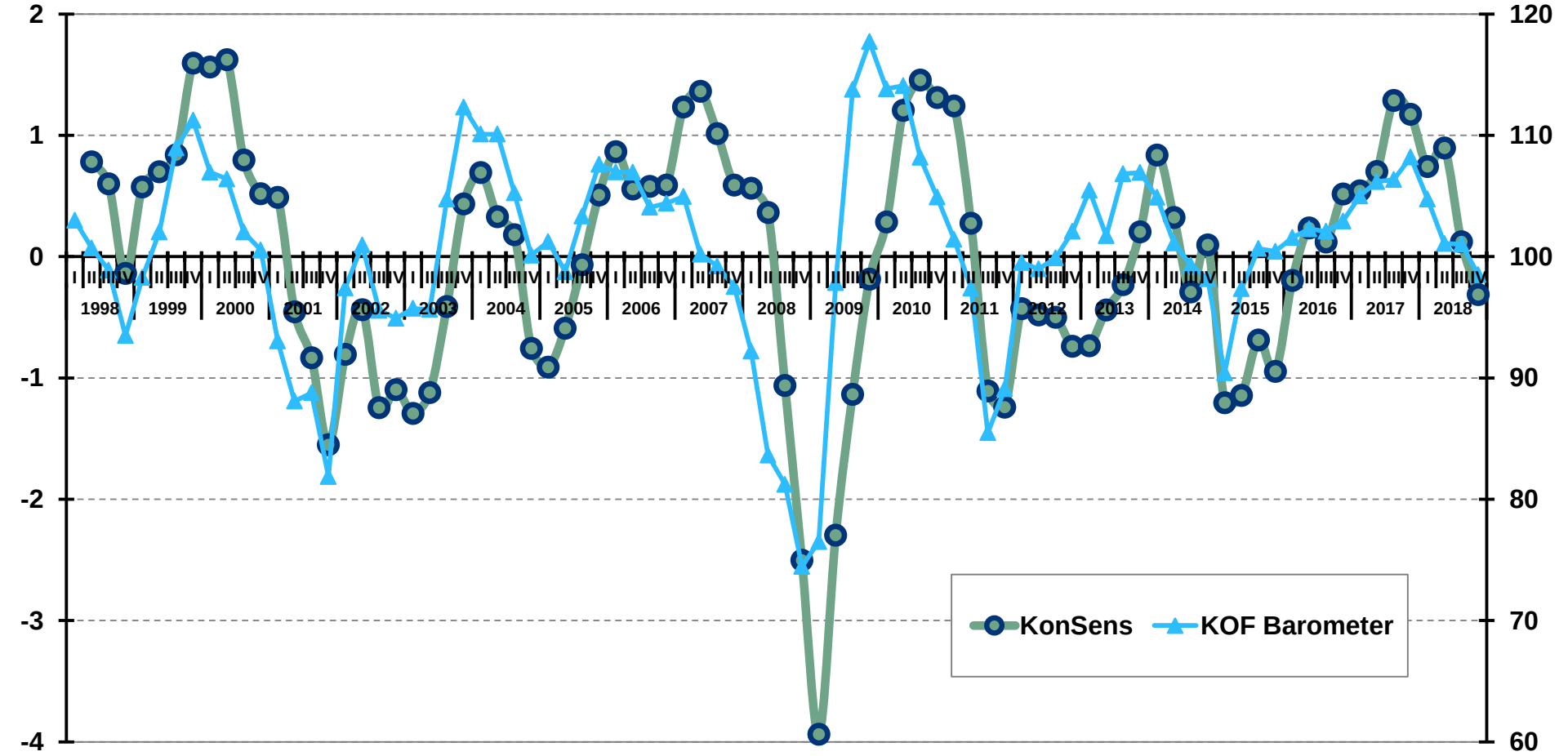
KonSens: Comparison with GDP



KonSens: Comparison with Composite Indicators



KonSens: Comparison with Composite Indicators



KonSens: Summary and Outlook

- KonSens: **Quarterly, coincident composite indicator** for Liechtenstein's business cycle
- First publication in **August 2019** (KonSens of 2nd Quarter 2019)
- Possible future **methodical improvments**: For example removal of indicator(s)? Settings seasonal adjustment? Dynamic factor model? Concentration on leading indicators?
- Planned extensions/modifications:
  - Inclusion of **new individual indicators**, when available?
  - KonSens as reference series for **qualitative prediction** of Liechtenstein's business cycle tendency (indirect way: e.g. ARDL-forecast with KonSens as dependent variable)
  - **Monthly** version of KonSens?

References

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Thanks for your attention!

Questions/Comments?

andreas.brunhart@liechtenstein-institut.li

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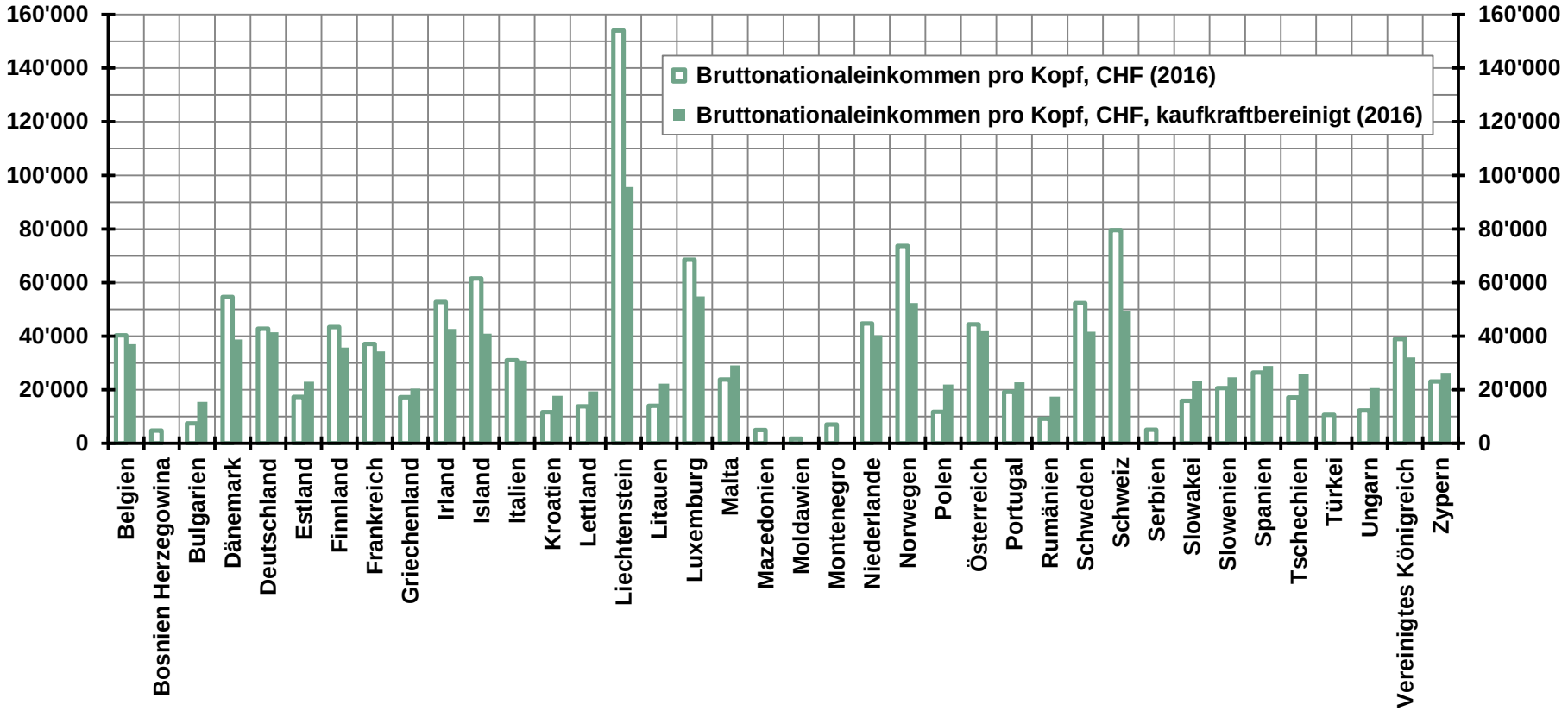
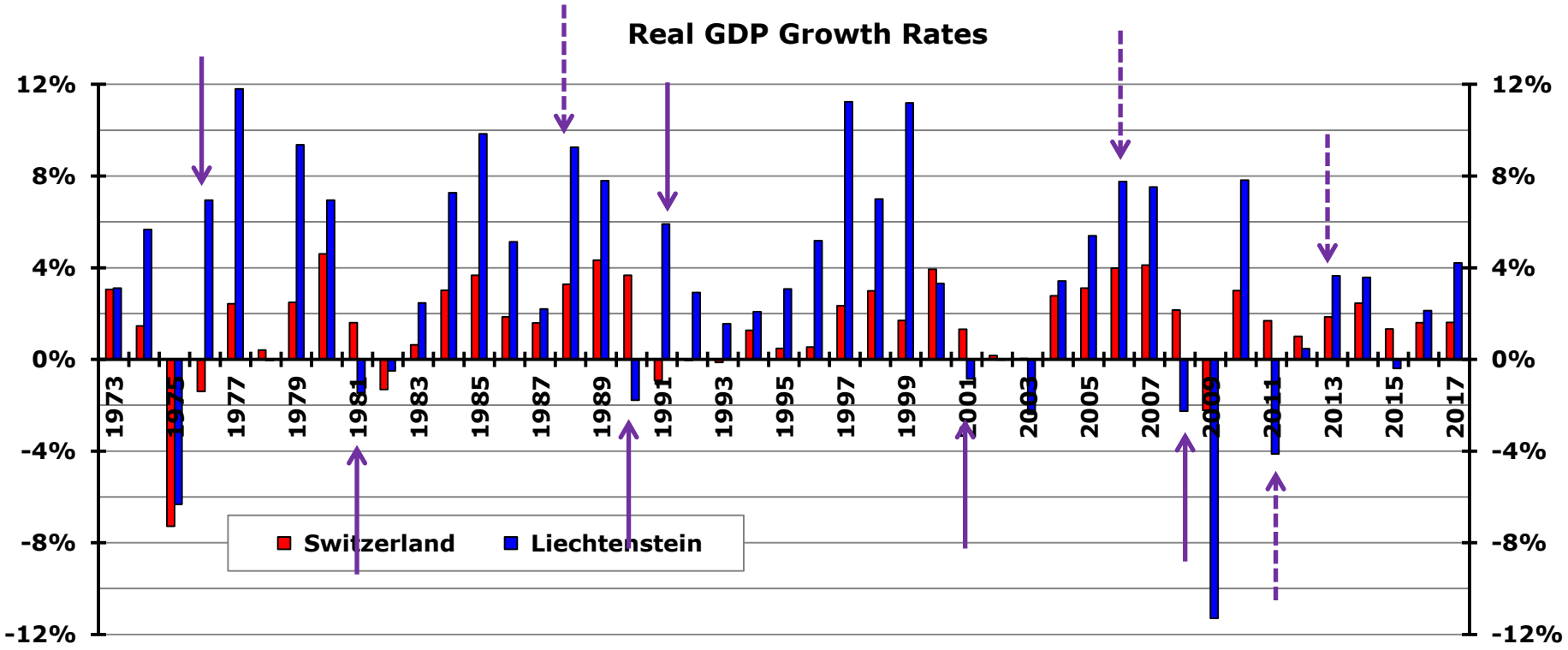
APPENDIX

Prologue: Closer Look on Liechtenstein's Economy

- Some key facts on Liechtenstein:



Prologue: Closer Look on Liechtenstein's Economy



KonSens

Principal Components Analysis
Date: 04/14/19 Time: 19:24
Sample (adjusted): 1998Q2 2018Q4
Included observations: 83 after adjustments
Balanced sample (listwise missing value deletion)
Computed using: Ordinary correlations
Extracting 16 of 16 possible components

Eigenvalues: (Sum = 16, Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	4.833300	2.815393	0.3021	4.833300	0.3021
2	2.017906	0.501904	0.1261	6.851206	0.4282
3	1.516002	0.244861	0.0948	8.367209	0.5230
4	1.271141	0.158707	0.0794	9.638350	0.6024
5	1.112434	0.140863	0.0695	10.75078	0.6719
6	0.971572	0.190510	0.0607	11.72236	0.7326
7	0.781062	0.115075	0.0488	12.50342	0.7815
8	0.665986	0.027075	0.0416	13.16940	0.8231
9	0.638911	0.083947	0.0399	13.80832	0.8630
10	0.554965	0.062772	0.0347	14.36328	0.8977
11	0.492192	0.107796	0.0308	14.85547	0.9285
12	0.384396	0.114668	0.0240	15.23987	0.9525
13	0.269728	0.052414	0.0169	15.50960	0.9693
14	0.217314	0.055044	0.0136	15.72691	0.9829
15	0.162270	0.051452	0.0101	15.88918	0.9931
16	0.110818	---	0.0069	16.00000	1.0000

Eigenvectors (loadings):

Variable	PC 1
AKT	0.227074
AL	-0.285742
BESCH	0.174901
ELVER	0.085043
EXP01	0.186436
IMP	0.121290
KONS	0.388205
KTAUFT	0.391593
KTAUSL	0.367466
KTERTR	0.331212
KTLAGE	0.356975
LIK	0.218599
LOGIER	0.087183
NEUZU	0.058942
OFFST	-0.017773
ZUP	0.210021