Synchronization or Asymmetry of Business Cycles at EU NUTS 3 level

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Workshop “The Impact of Economic Integration on Regional Business Cycles Synchronization”
www.euro4europe.vu.lt
2021 05 07

The project “Euro4Europe” (No 09.3.3-LMT-K-712-0-123) has received funding from the European Social Fund under a grant agreement with the Research Council of Lithuania (LMT.LT)
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Motivation &
Research Question

Data & empirical approach

Preliminary results & further steps

WHY?

- Comovement in a sectoral business cycle can happen due to common shocks or to vertical linkages (Duval et al, 2014; Shea, 2002).
- Some literature do not capture the trade co-movement relationship, thus this can be addressed by exploring more granular data such as sectoral data at EU NUTS 3 scale.
- Interestingly, NUTS 2, NUTS 3 levels allow to look at one country regions as well as at many countries various regions. Also, we can look at different sectors BC patterns in the same region. Do regions converge? Do sectors in regions converge? What are the factors, having in mind that this could be the same country and the same NUTS 2 region for NUTS 3 regions.
- In the setting of one country we have the same currency, same fiscal policy, free trade and free labour migration. Transmission of shocks from sector to sector or from region to region? Controlling for region, country & global factors, spatial or other factors?
- Aim is to contribute by applying the analyses of regional sectors BC co-movement to the EU at NUTS3 scale. Identification of the channels for shock transmission can provide adequate policy responses. This work will contribute to the literature by exploring linkages in BC comovement for GVA PPS and employment at EU NUTS3 scale.

RELATED LITERATURE

- **Business cycle synchronization, sectoral comovement**.
  Abiad et al (2013); Duval et al. (2014); Shea (2002)

- **Regional Economic Integration**.
  Bierbaumer-Polly, Huber & Rozmahel (2016), Bandres et al (2017), Cainelli et al. (2021)

DATA

- NUTS 3 level (~ 1800), 5 main sectors: **A** - Agriculture, Forestry and Fishing, **BE** – Industry, **F** – Construction, **GJ** - Wholesale, Retail, Transport, Accommodation & Food Services, Information and Communication, **KN** - Financial & Business Services

- Period: 1980 – 2018 (old EU countries), 1990/1995 – 2018 (new EU countries); frequency – year

- Variables: employment, GVA PPS

NUTS (Nomenclature of territorial units for statistics)

Criteria:

a) Administrative unit,

b) the average size of this class of administrative units in the Member State shall lie within the population thresholds (see above),

c) the population of a territorial unit shall consist of those persons who have their usual place of residence in this area.

Level	Minimum	Maximum
NUTS 1	3 million	7 million
NUTS 2	800 000	3 million
NUTS 3	150 000	800 000

Codes & names of NUTS3 regions of the Baltic States

EE001	Põhja-Eesti	LT011	Vilniaus apskritis
EE004	Lääne-Eesti	LT021	Alytaus apskritis
EE006	Kesk-Eesti	LT022	Kauno apskritis
EE007	Kirde-Eesti	LT023	Klaipedos apskritis
EE008	Lõuna-Eesti	LT024	Marijampoles apskritis
LV003	Kurzeme	LT025	Panevezio apskritis
LV005	Latgale	LT026	Siauliu apskritis
LV006	Riga	LT027	Taurages apskritis
LV007	Pieriga	LT028	Telsiu apskritis
LV008	Vidzeme	LT029	Utenos apskritis
LV009	Zemgale		

EMPIRICAL APPROACH

- **Coefficient of variance:** $CV = \frac{\sigma_{kt}}{g_{kt}}$
- **BC synchronization:**

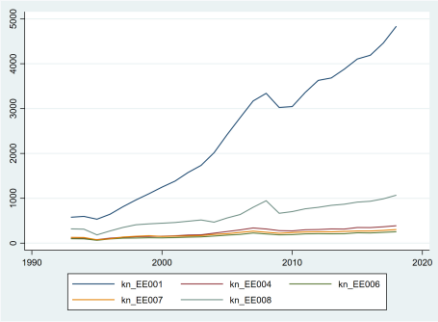
- correlation of time series: ln GVA PPS filtered by HP, λ = 6.25
- quasi correlation: first difference of ln GVA pps/employment in region *i* of industry *k* in time t.

$$QCorr_{ijt} = \frac{(g_{ikt} - g^*_{ik}) * (g_{jkt} - g^*_{jk})}{\sigma^g_{ik} * \sigma^g_{jk}}$$

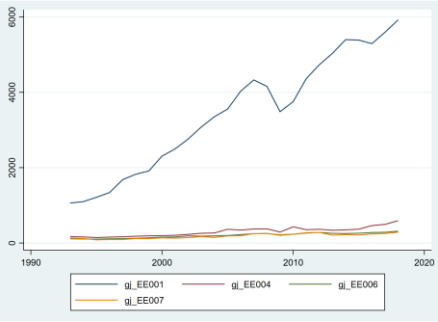
Where $QCorr_{ijt}$ – quasi correlation of GVA growth rates of regions *i* & *j of k* industry, g_{it}- outuput growth rate of region *i* in year *t* , g^*_i and σ^g_i denotes the mean and standard deviation of output growth rate of region *i of* industry *k* in sample period. The growth rate is measured as the first difference of the ln of GVA PPS/Employment.

- **Further models under consideration:** Dynamic factor model, VAR, SVAR, Granger

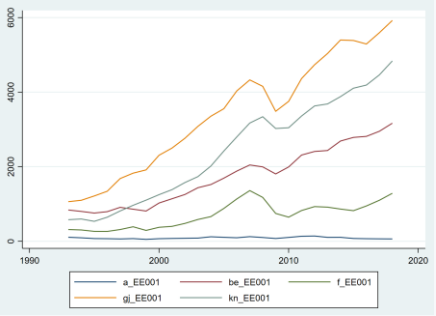
RAW data. Estonia NUTS 3 regions, sectors A, B_E, F, GJ, KN



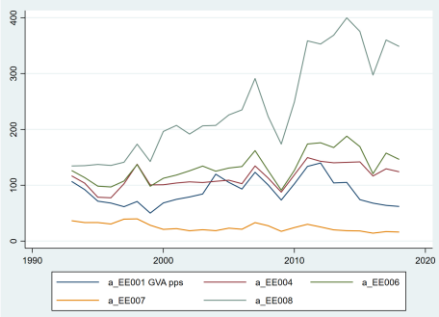
KN sectors of Estonia NUTS 3 regions



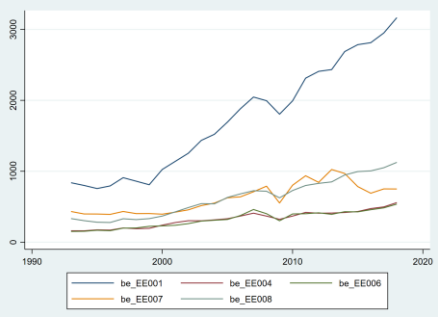
GJ sectors of Estonia NUTS 3 regions



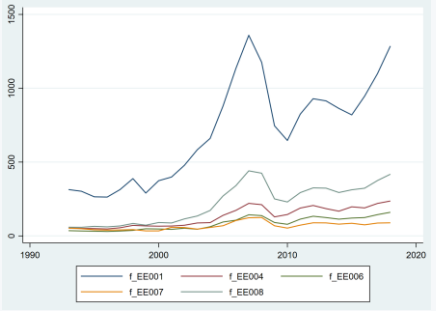
Estonia EE001, all sectors



A sector of Estonia NUTS 3 regions



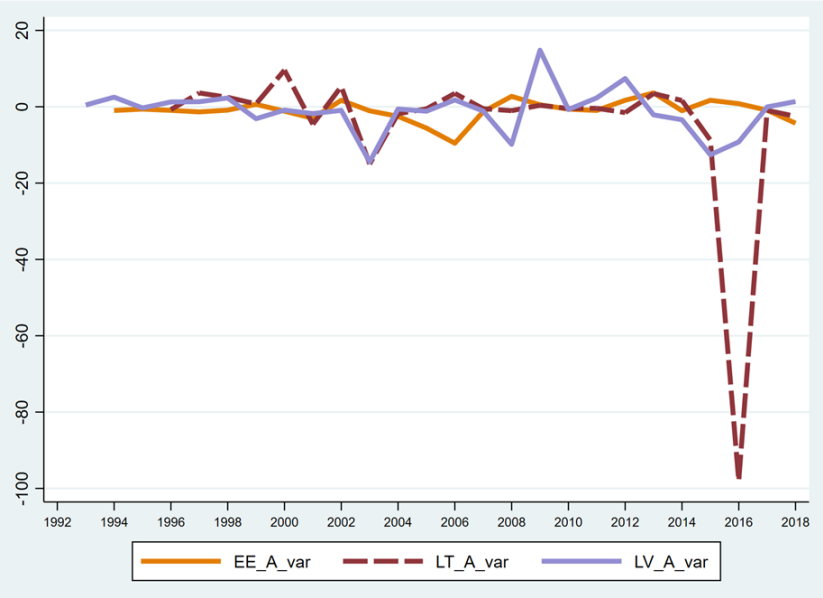
B_E sectors of Estonia NUTS 3 regions

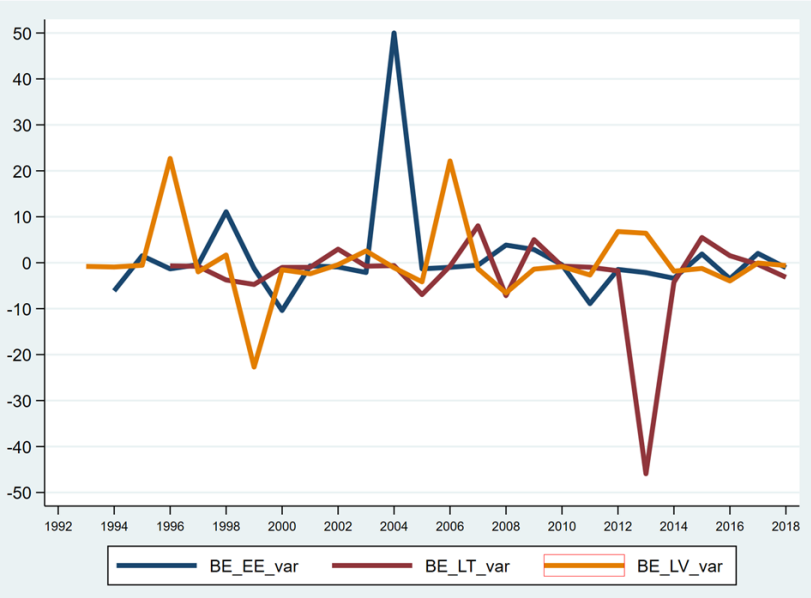


F sector of Estonia NUTS 3 regions

SOME RESULTS (THE BALTIC STATES SAMPLE)

Coefficient of variance $CV = \frac{\sigma_{kt}}{\overline{g_{kt}}}$





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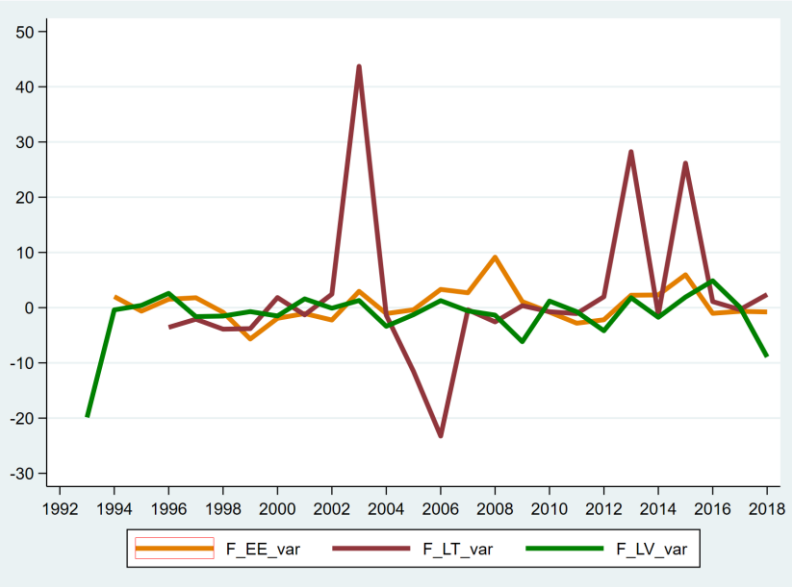
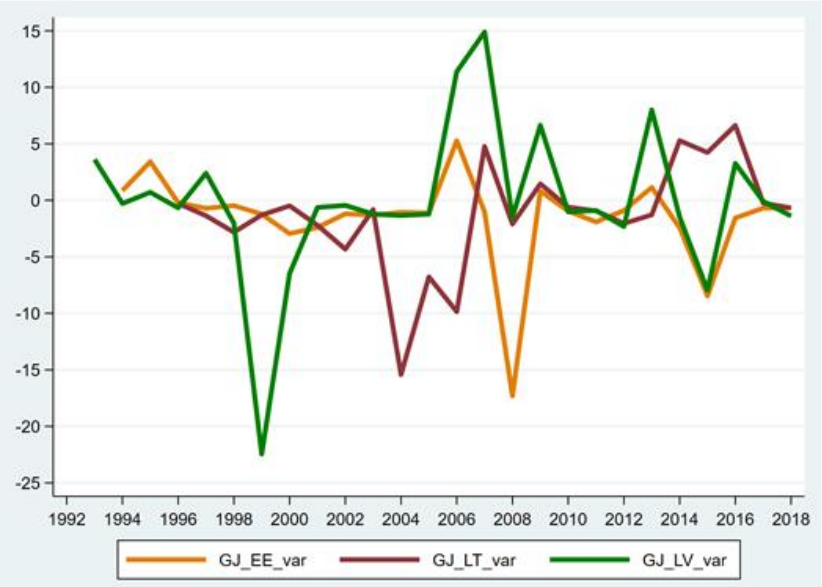
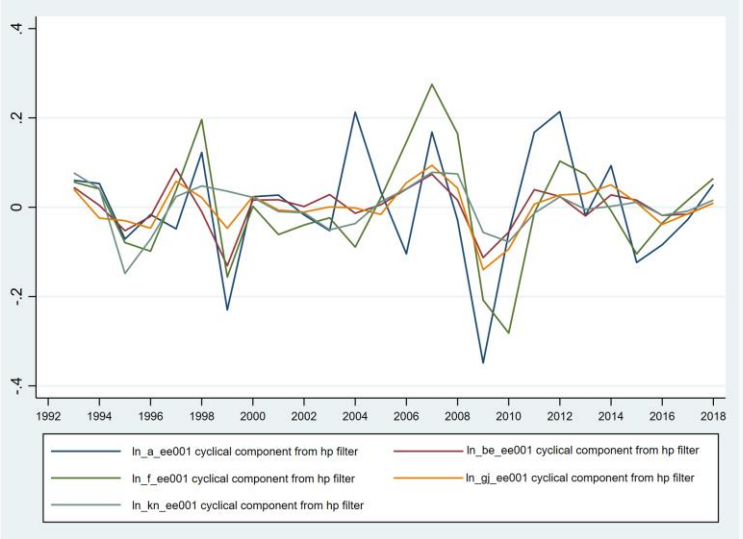
Coefficient of variance $CV = \frac{\sigma_{kt}}{g_{kt}}$





Estonia NUTS 3 regions, sectors A, B_E, F, GJ, KN

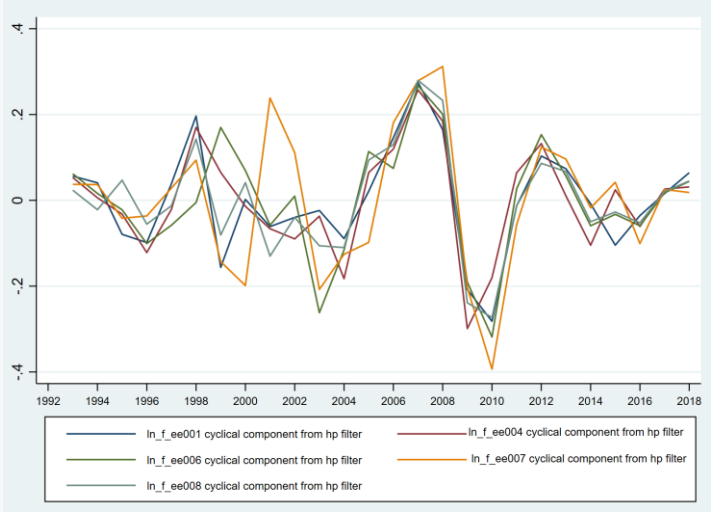
A sector, different regions



Different sectors, one region

Estonia NUTS 3 regions, sectors BE, F

BE sector



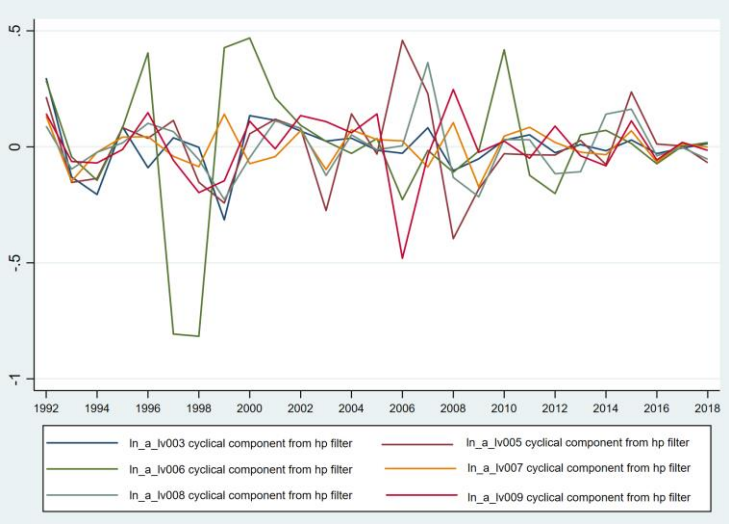
F sector

Estonia NUTS 3 regions, sectors GJ, KN

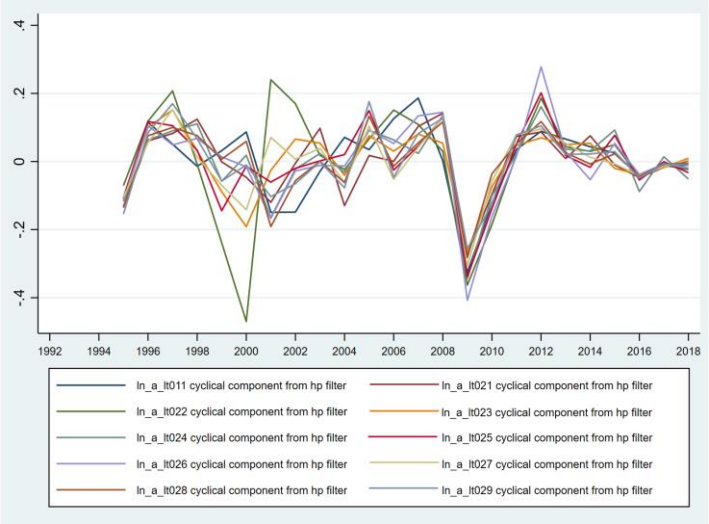
GJ sectors

KN sector

Lithuania & Latvia NUTS 3 regions, A sector



Latvia



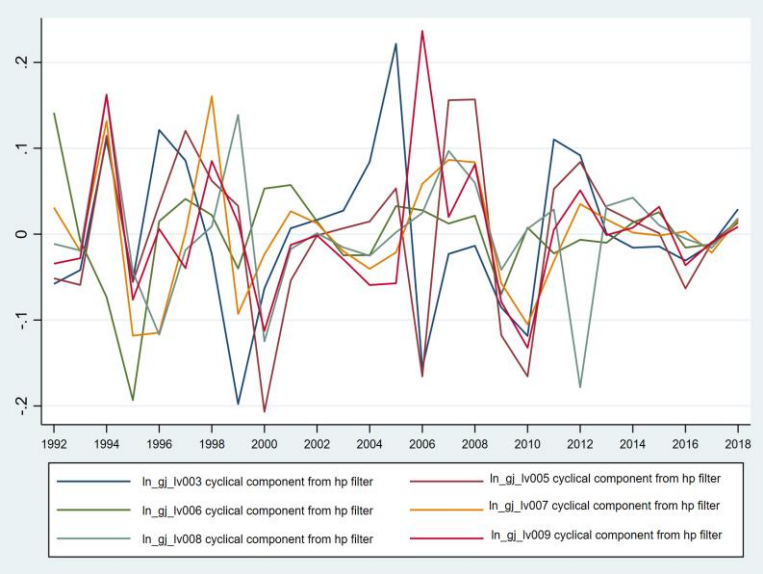
Lithuania

Lithuania & Latvia NUTS 3 regions, BE sector

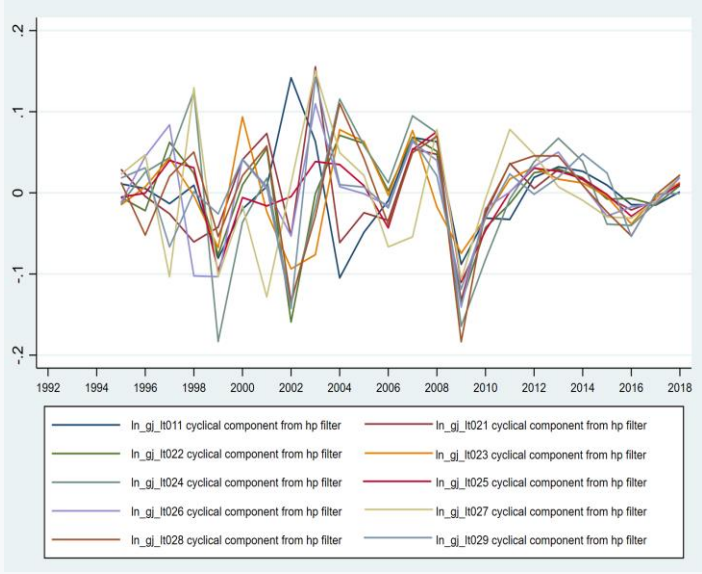
Latvia

Lithuania

Lithuania & Latvia NUTS 3 regions, GJ sector

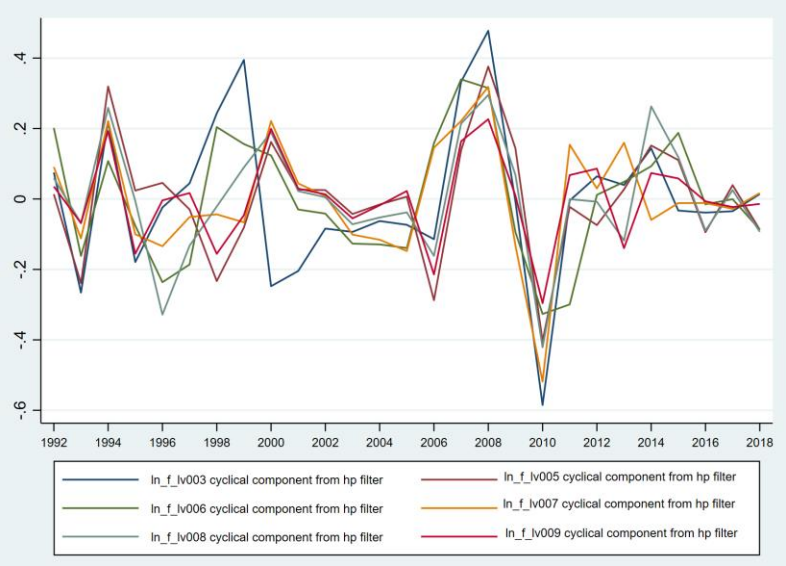


Latvia

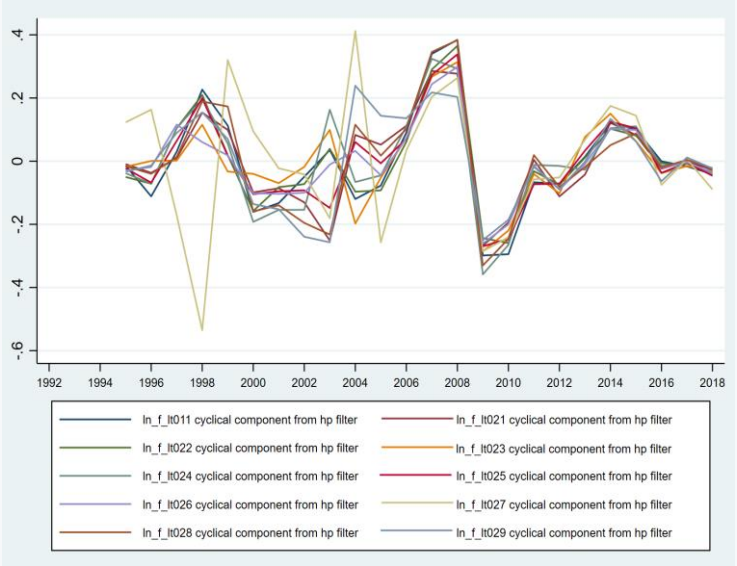


Lithuania

Lithuania & Latvia NUTS 3 regions, F sector

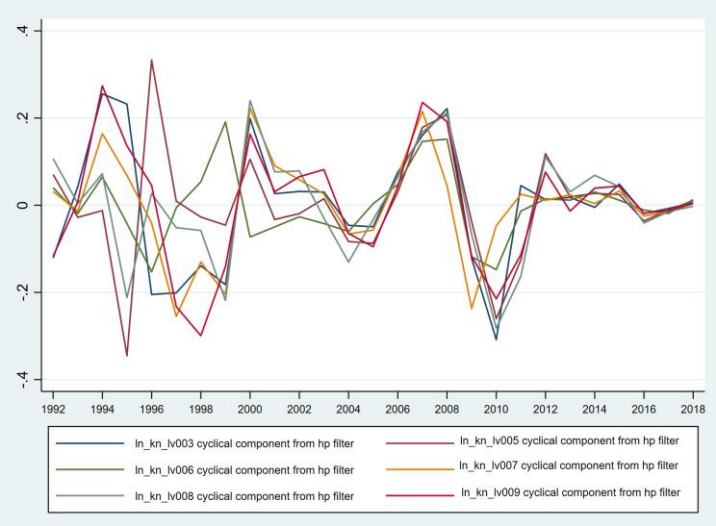


Latvia

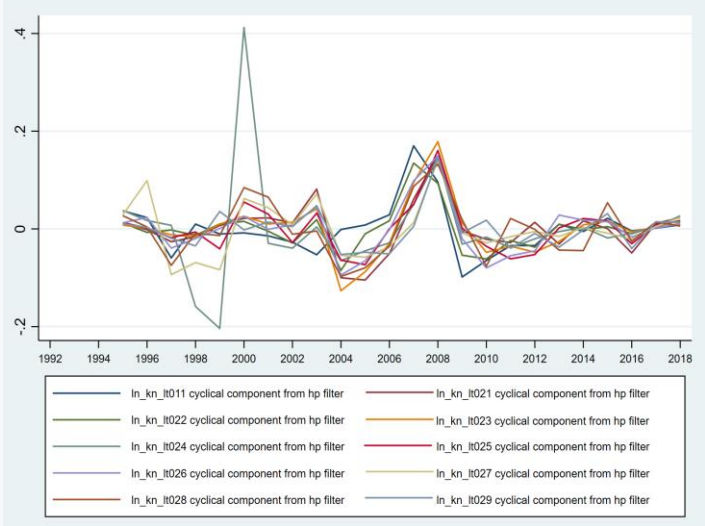


Lithuania

Lithuania & Latvia NUTS 3 regions, KN sector



Latvia



Lithuania

Some pairwise correlation results on BC HP. Estonia

Pair of sectors	Region
	EE001
A_BE	0.61***
A_F	0.52***
A_GJ	0.58***
A_KN	0.27
BE_F	0.65***
BE_GJ	0.82***
BE_KN	0.46**
F_GJ	0.82***
F_KN	0.69***
GJ_KN	0.64***

Region pair	A	BE	F	GJ	KN
EE001_EE004	0.66***	0.78***	0.82***	0.17	0.90***
EE001_EE006	0.74***	0.54***	0.69***	0.63***	0.85***
EE001_EE007	0.55***	0.51***	0.75***	0.34*	0.87***
EE001_EE008	0.76***	0.83***	0.91***	0.64***	0.89***
EE004_EE006	0.87***	0.67***	0.81***	0.41**	0.97***
EE004_EE007	0.81***	0.48**	0.64***	0.49**	0.88***
EE004_EE008	0.71***	0.70***	0.89***	0.55**	0.83***
EE006_EE007	0.78***	0.62***	0.66***	0.68***	0.91***
EE006_EE008	0.90***	0.68***	0.83***	0.55***	0.83***
EE007_EE008	0.67***	0.61***	0.72***	0.34**	0.81***

Some pairwise correlation results on BC HP. Latvia

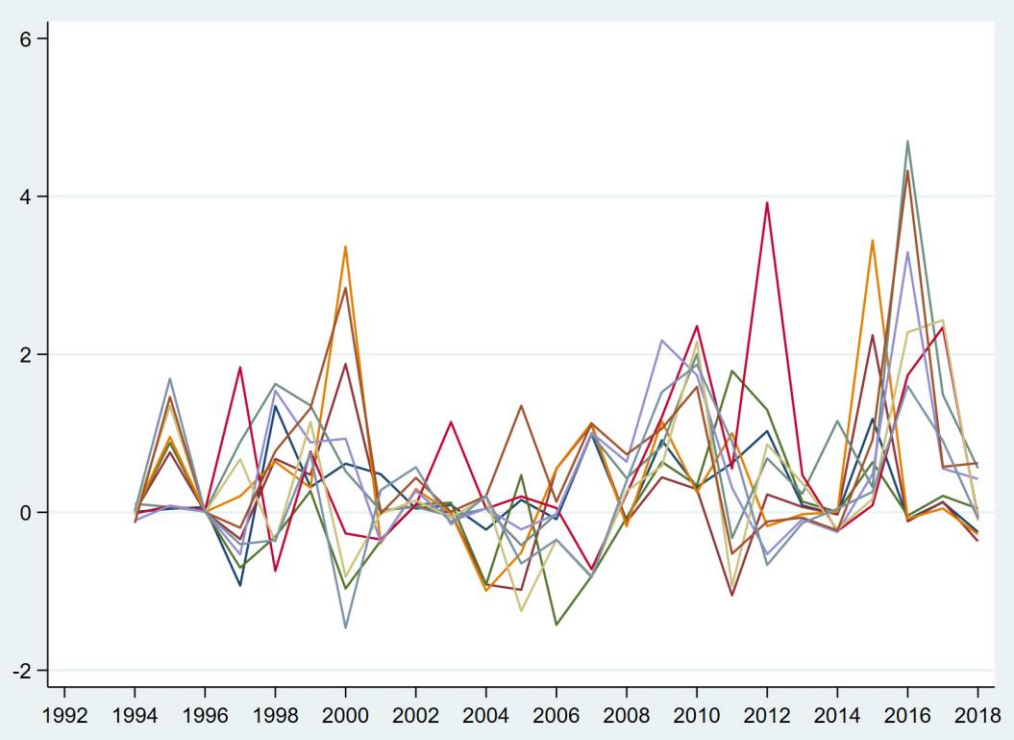
Region pair	A	BE	F	GJ	KN
LV003_LV005	0.54***	0.58***	0.53***	0.54***	0.07
LV003_LV006	0.06	0.39**	0.66***	0.05	0.33*
LV003_LV007	0.03	0.11	0.58***	0.12	0.76***
LV003_LV008	0.50***	0.46**	0.62***	-0.20	0.52***
LV003_LV009	0.26	0.41**	0.51***	-0.02	0.84***
LV005_LV006	0.01	0.21	0.41**	-0.03	0.22
LV005_LV007	0.16	0.21	0.60***	0.42**	0.19
LV005_LV008	0.65***	0.28	0.77***	0.36*	0.76***
LV005_LV009	-0.28	-0.18	0.83***	0.33*	0.36*
LV006_LV007	0.29	0.09	0.65***	0.32*	0.12
LV006_LV008	0.03	0.32	0.69***	-0.11	0.27
LV006_LV009	0.37**	-0.06	0.39**	0.05	0.20
LV007_LV008	0.10	0.48**	0.65***	0.34*	0.58***
LV007_LV009	0.24	0.46**	0.65***	0.66***	0.80***
LV008_LV009	0.06	0.60***	0.76***	0.40**	0.61***

Some pairwise correlation results on BC HP. Lithuania

Region pair	A	BE	F	GJ	KN
LT011_LT021	0.65***	0.84***	0.82***	0.48**	0.33
LT011_LT022	0.29	0.89***	0.98***	-0.05	0.81***
LT011_LT023	0.55***	0.85***	0.92***	-0.22	0.49**
LT011_LT024	0.77***	0.74***	0.94***	0.13	0.20
LT011_LT025	0.70***	0.66***	0.92***	0.52***	0.50**
LT011_LT026	0.82***	0.85***	0.92***	0.37*	0.65***
LT011_LT027	0.49**	0.69***	0.27	0.29	0.31
LT011_LT028	0.77***	0.80***	0.86***	-0.04	0.49**
LT011_LT029	0.70***	-0.03	0.66***	0.14	0.25
LT021_LT022	0.47**	0.90***	0.80***	0.44**	0.65***
LT021_LT023	0.80***	0.77***	0.69***	0.10	0.91***
LT021_LT024	0.86***	0.70***	0.76***	0.29	0.37*
LT021_LT025	0.76***	0.65***	0.94***	0.52***	0.83***
LT021_LT026	0.82***	0.81***	0.88***	0.75***	0.83***
LT021_LT027	0.78***	0.49**	0.43**	0.32	0.73***
LT021_LT028	0.85***	0.72***	0.98***	0.43**	0.77***
LT021_LT029	0.86***	0.17	0.93***	0.79***	0.88***

Region pair	A	BE	F	GJ	KN
LT022_LT023	0.84***	0.87***	0.92***	0.74***	0.80***
LT022_LT024	0.47**	0.80***	0.95***	0.88***	0.34*
LT022_LT025	0.62***	0.77***	0.92***	0.70***	0.72***
LT022_LT026	0.50**	0.91***	0.94***	0.62***	0.87***
LT022_LT027	0.78***	0.65***	0.21	0.15	0.42**
LT022_LT028	0.27	0.80***	0.84***	0.90***	0.65***
LT022_LT029	0.49**	0.10	0.66***	0.60***	0.49**
LT023_LT024	0.73***	0.83***	0.88***	0.68***	0.39*
LT023_LT025	0.79***	0.80***	0.82***	0.49**	0.89***
LT023_LT026	0.71**	0.79***	0.86***	0.46**	0.93***
LT023_LT027	0.91***	0.71***	0.24	0.04	0.66***
LT023_LT028	0.6&***	0.79***	0.70***	0.71***	0.81***
LT023_LT029	0.79***	0.03	0.50**	0.37**	0.81***
LT024_LT025	0.91***	0.87***	0.86***	0.82***	0.57***
LT024_LT026	0.92***	0.84***	0.93***	0.53***	0.41**
LT024_LT027	0.73***	0.58***	0.22	0.41**	0.60***
LT024_LT028	0.73***	0.82***	0.82***	0.83***	0.50**
LT024_LT029	0.92***	-0.14	0.67***	0.51**	0.26

Estonia A sector, different NUTS3 pairs Q correlation



Further steps

Dynamic factor model

$$y_t^i = b_1^i f_t^{region(j)} + b_2^i f_t^{country(k)} + b_3^i f_t^{subregion(m)} + b_4^i f_t^{global} + u_t^i$$

$$u_t^i = \varphi_1^i u_{t-1}^i + \varphi_2^i u_{t-2}^i + \varepsilon_t^i, \qquad \varepsilon_t^i \sim N(0, \sigma_{\varepsilon i}^2)$$

$$u_t^i = \varphi_1 f_{t-1} + \varphi_2 f_{t-2} + \eta_t, \qquad \eta_t \sim N(0, \sigma_\eta^2)$$

y_t^i – vector of GVA growth rate of industry, f_t – factors, u_t^i – residuals

Factors & residuals are following an AR(2) process

VAR model

$$Y_t = a_0 + a_1 Y_{t-1} + \cdots + a_p Y_{t-p} + b_1 X_{t-1} + \cdots + b_p X_{t-p} + u_t$$

$$X_t = a_0 + c_1 X_{t-1} + \cdots + c_p X_{t-p} + d_1 Y_{t-1} + \cdots + d_p Y_{t-p} + v_t$$

Setting up a model & controlling for regional, country, global, urbanization, distance & etc. factors

Challenge: number of degrees of freedom

QUESTIONS, SUGGESTION?

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