Regional Business Cycle Synchronization in the Long Run: Evidence from Austria

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MOTIVATION

- Co-movement of time series between countries and regions is a major concern in many areas of economics.
- In particular recent theoretical and empirical contributions to international business cycle theory argue that co-movement
  - may differ across different frequencies (e.g. Rua, 2010)
  - may evlove over time (with very different predictions as to how e.g. Frankel and Rose, 1997 vs Krugmann, 1993 for business cycle frequencies)
- There is ample research on comovement of economic time series across countries but less at the regional level. This encompases:
  - European NUTS 2 level research: focusing on EURO adoption and determinants (Montoya & de Haan 2008, Siedschlag & Tondl, 2011, Bierbaumer-Polly et al. 2016)
  - Research on individual countries - mostly focusing on the US (e.g. Park and Hewings, 2012, Chung & Hewings, 2015)
- Yet, the analysis of regional data within countries may be of interest for economists
  - Provide a benchmark of how synchronization actually evolves in a currency union
  - May be a testing ground for alternative theories of factors explaining business cycle correlation

THIS PAPER

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  - Provide a benchmark of how synchronization actually evolves in a currency union
  - May be a testing ground for alternative theories of factors explaining business cycle correlation

RESULTS

- Heterogeneity
  - is large for almost all frequencies
  - is mainly related to time invariant region fixed effects for short and long frequencies, but by commen time effects for business cycle frequencies
  - co-movement at low and high frequencies is lower than at business cycle frequencies for regional employment while no such clear result appears in the unemployment
- Trends
  - There is some evidence of an upward trend in co-movement at most frequencies
  - At business cycle frequencies this is mainly due to upward trend in the 1990‘s
  - There are aslo some signs of a decoupelling of Vienna at business cycle frequencies for employment rates
- Correlates
  - Differences in sectoral employment shares (structural difference) are negatively correlated co-movement at business cycle frequencies and higher
  - Out and in-commuting are mostly positively correlated
  - More distant regions have lower comovement and neighboring regions higher comovement at all frequencies

CONTENT

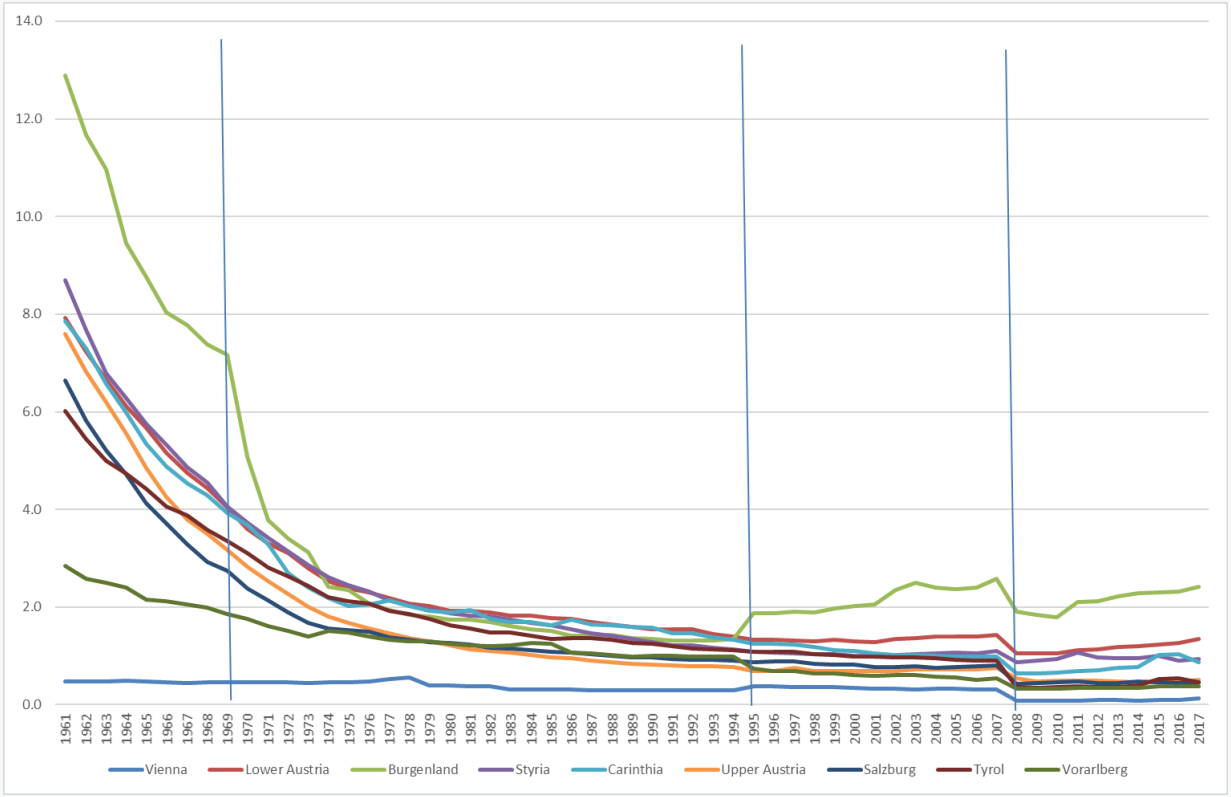
- Prelude on Austria
- Data
- Method
- Results
- Conclusion

AUSTRIA 1956-2015

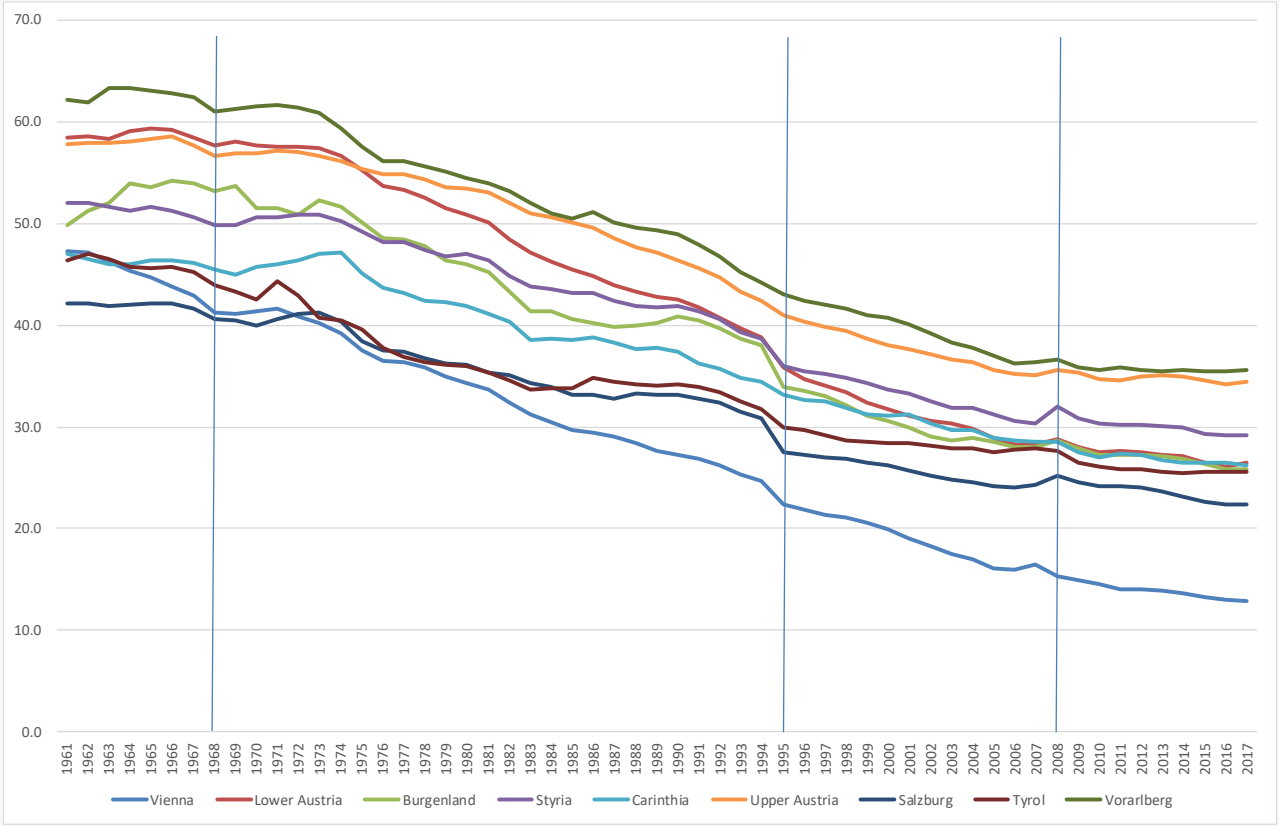
- Massive change in economic structure
- increased labour mobility
- and reduced transport costs


CZECH REPUBLIC
GERMANY
Lower Austria
SK
Upper Austria
Vienna
Vorarl-
berg
Tyrol
Salzburg
Styria
Burgenland
HUNGARY
SWITZER
LAND
ITALY
Carinthia
SLOVENIA

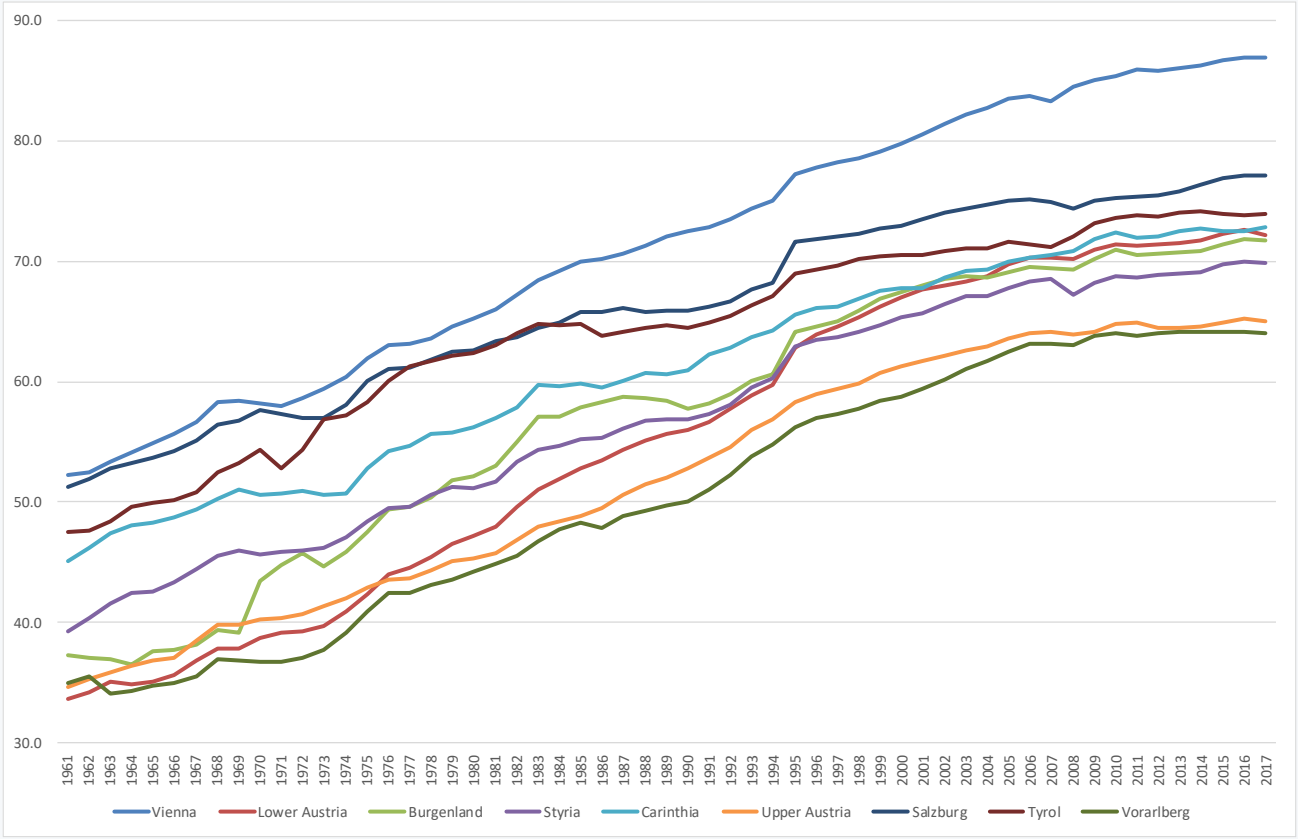
EMPLOYMENT PRIMARY SECTOR



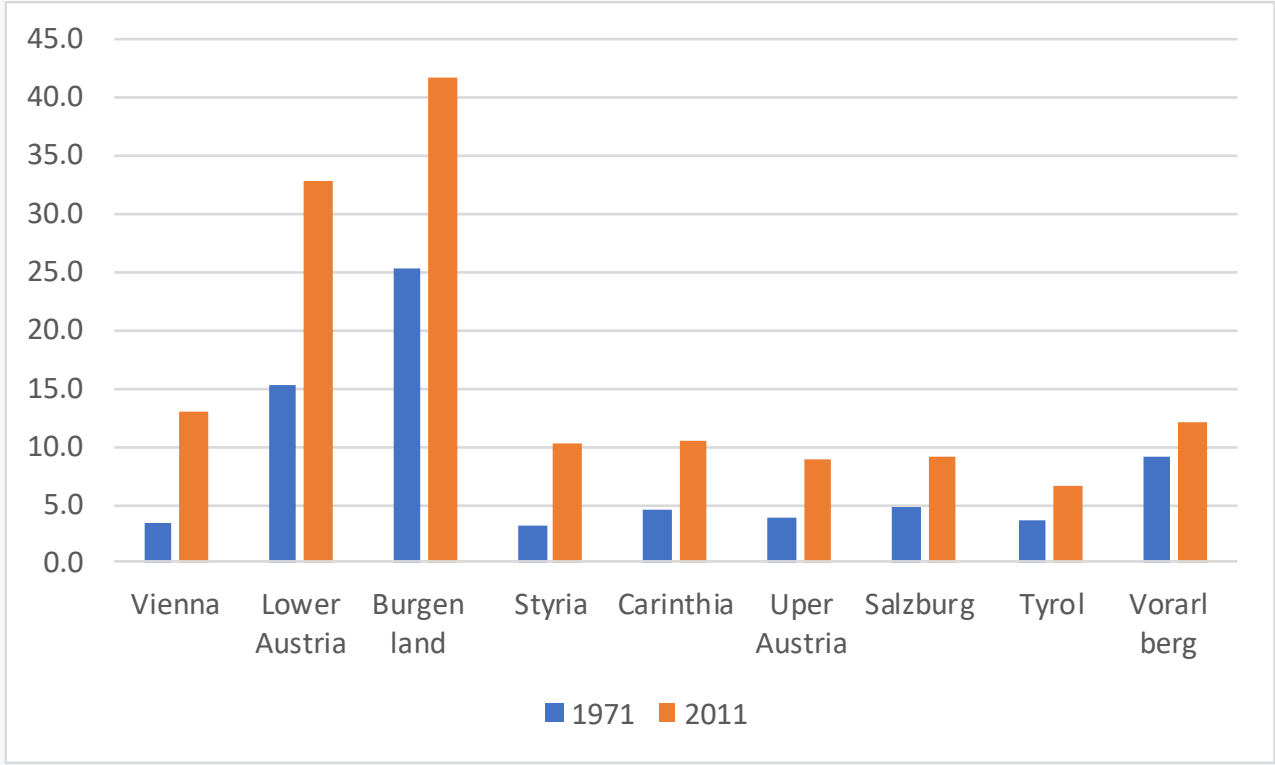
EMPLOYMENT SECONDARY SECOR



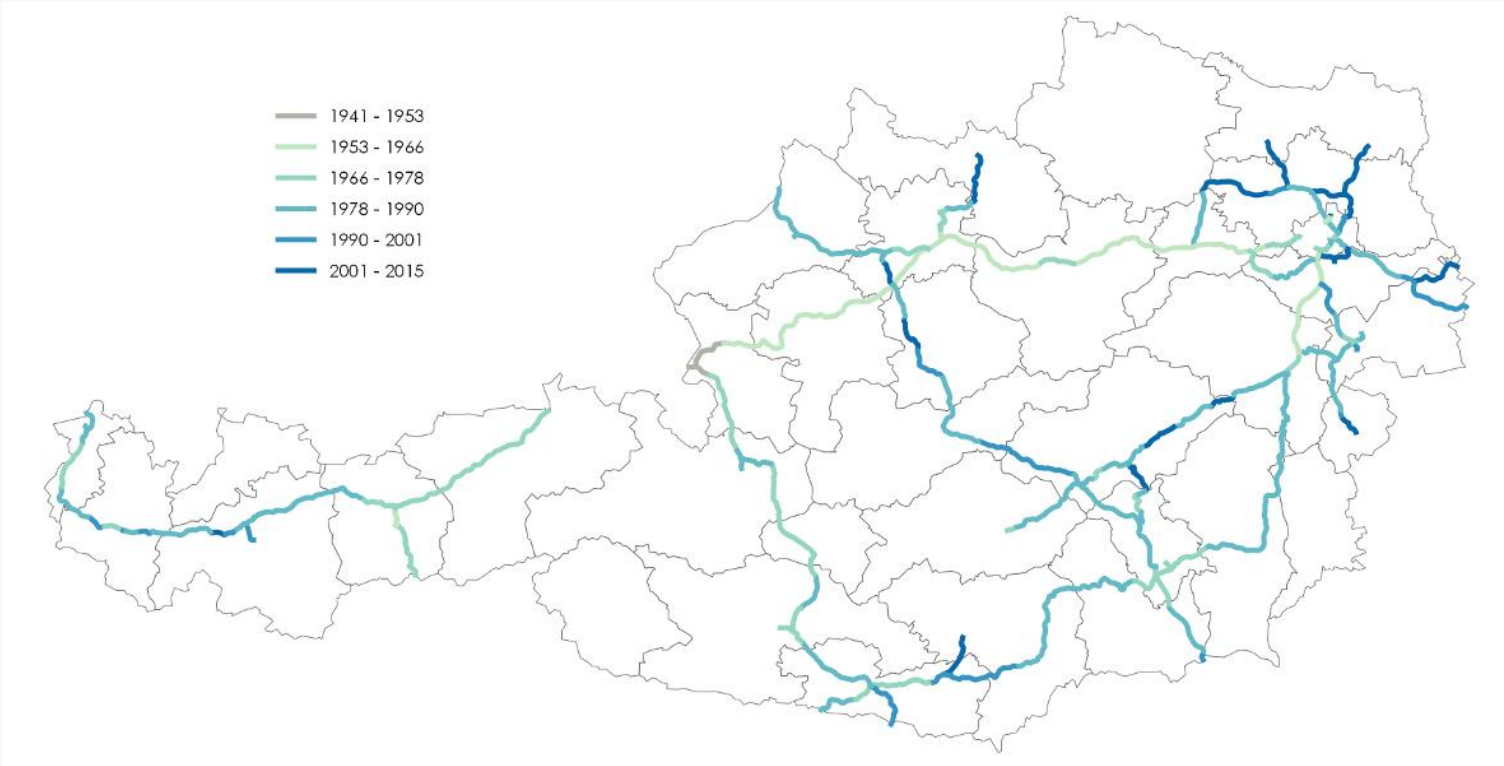
EMPLOYMENT TERTIARY SECTOR



OUT- COMMUTING (ACROSS PROVINCE BORDERS)



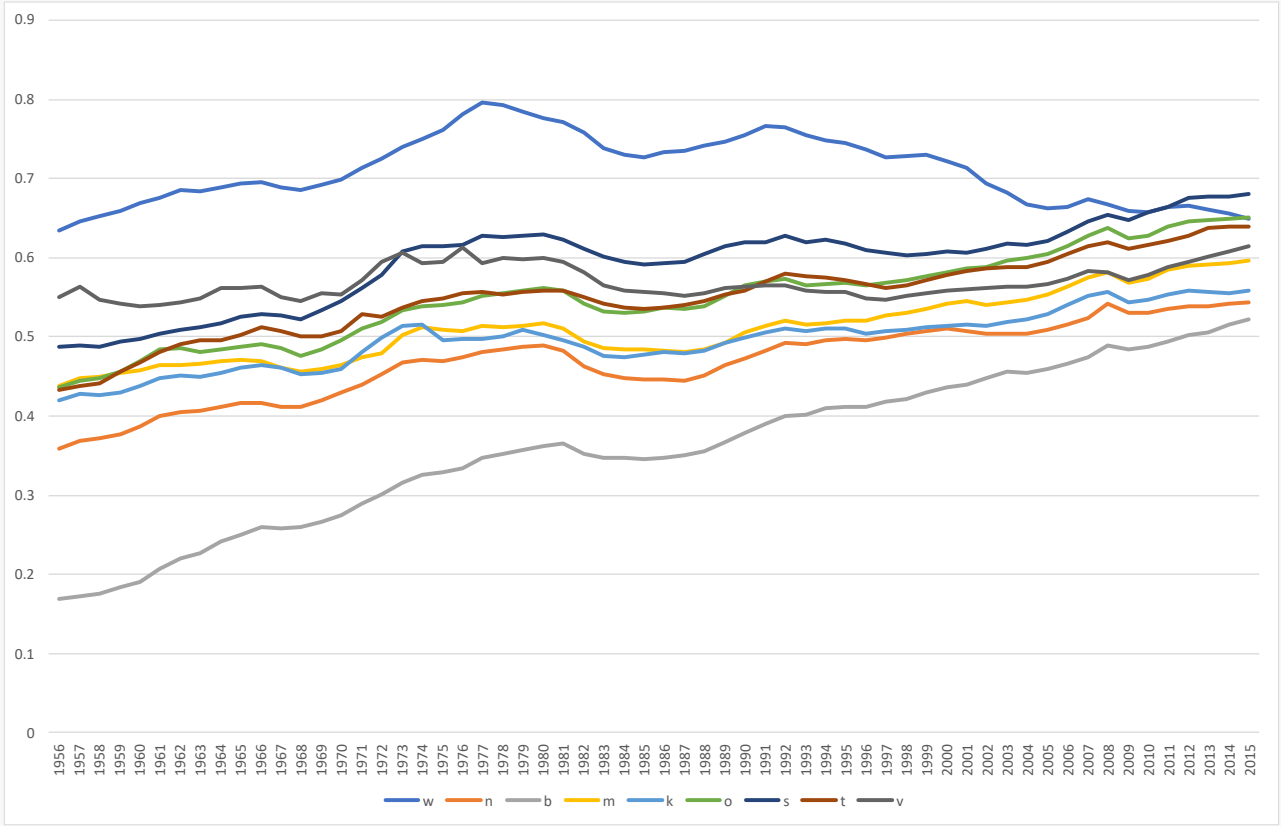
HIGHWAYS BY YEAR OF CONSTRUCTION



DATA

- Monthly data on employees (from Jan. 1956 to dec. 2015) and unemployed (Jan 1960 to Dec 2015) for 9 provinces (Bundesländer=NUTS2)
- Taken from data from the ASSD
  - Consistent definitions of variables in all time periods
  - Some changes in defintions over time (depending on social security legislation) these, however, affect all regions alike
- Is the official employment and unemployment statistics rate used for business cycle analysis by most analysts
- merged with data on
  - Commuting
  - Sector employment structure
  - distance between capitals
  - neighborhood

EMPLOYMENT RATES



METHOD

- For both series: Employement rate, Unemployment rate

- Preferred method: Cross-Spectrum Analysis
  - coherence = correlation
  - phase shift = lead lag structure:
- Advantage
  - Provides estimates at (arbitrary) specific frequencies for all time periods
  - Can be estimated at each observation

- To check for robustness: 6 year rolling window correlation based on Baxter-King filtered series

TERMINOLOGY

Frequencies

- 1-5 months => noise
- 6-8 months => short seasonality
- 9-16 months => long seasonality
- 17-36 months => high BC frequencies (BC short)
- 37-96 months => low BC frequencies (BC ong)
- 97-132 months => Juglar cycles,
- 133-256 months => Long Cycles

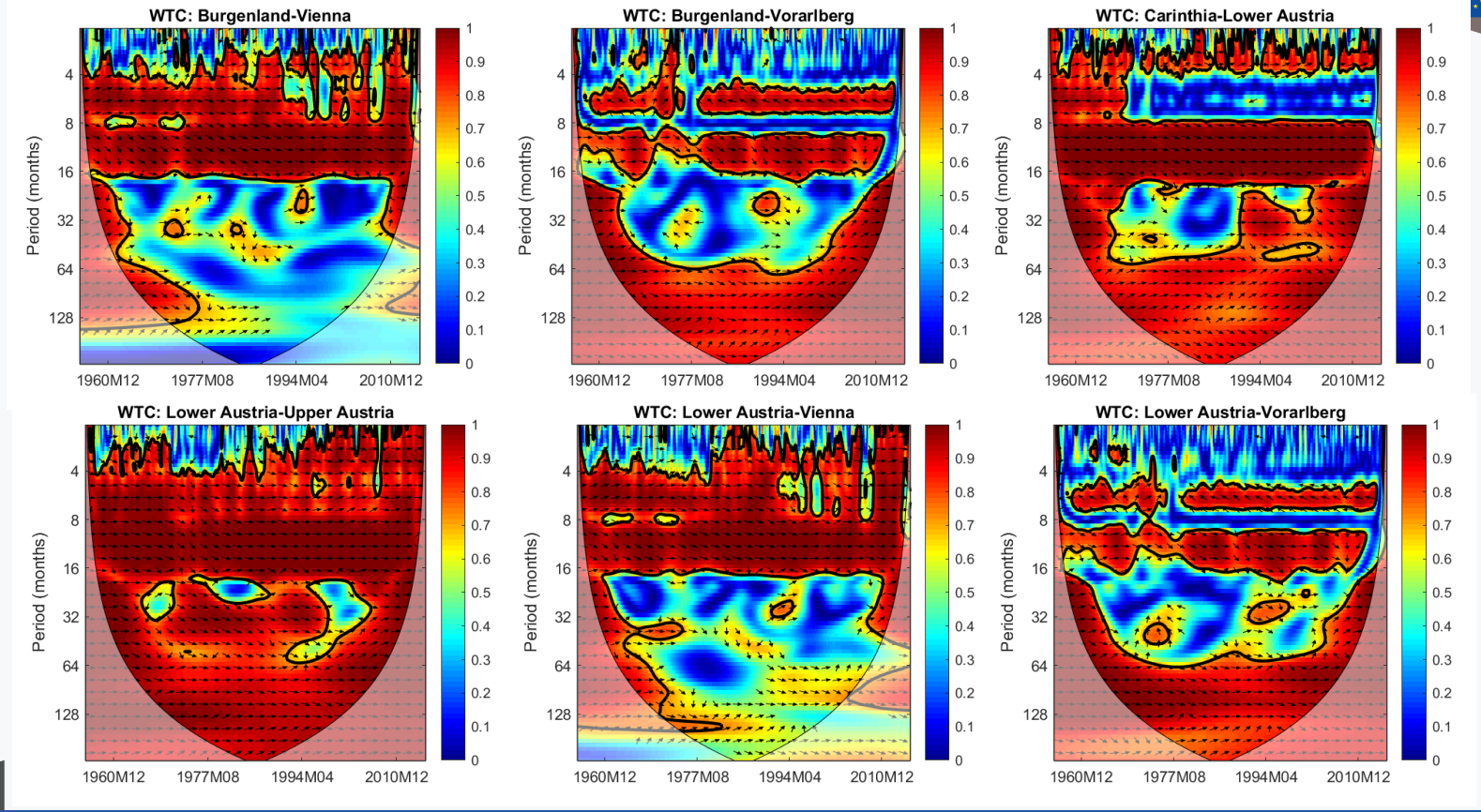
Periods

- 1955-1970 -> Post war
- 1971-1990 -> Austro-Keynesianism (Austrian employment miracle)
- 1990-2015 -> intensified Globalisation

- Heterogeneity

- Trend
  - H1: regions became structurally more similar and transport costs seem to have reduced: Co-movement should increase.

- Correlates
  - H2: greater sector difference in employment should reduce co-movement
  - H3: more labour market flows should increase co-movement
  - H4. distance between two regions should be negatively correlated to co-movement and neighbours should have higher co-movement
  - H4½ better transport-infrastructure should increase co-movement

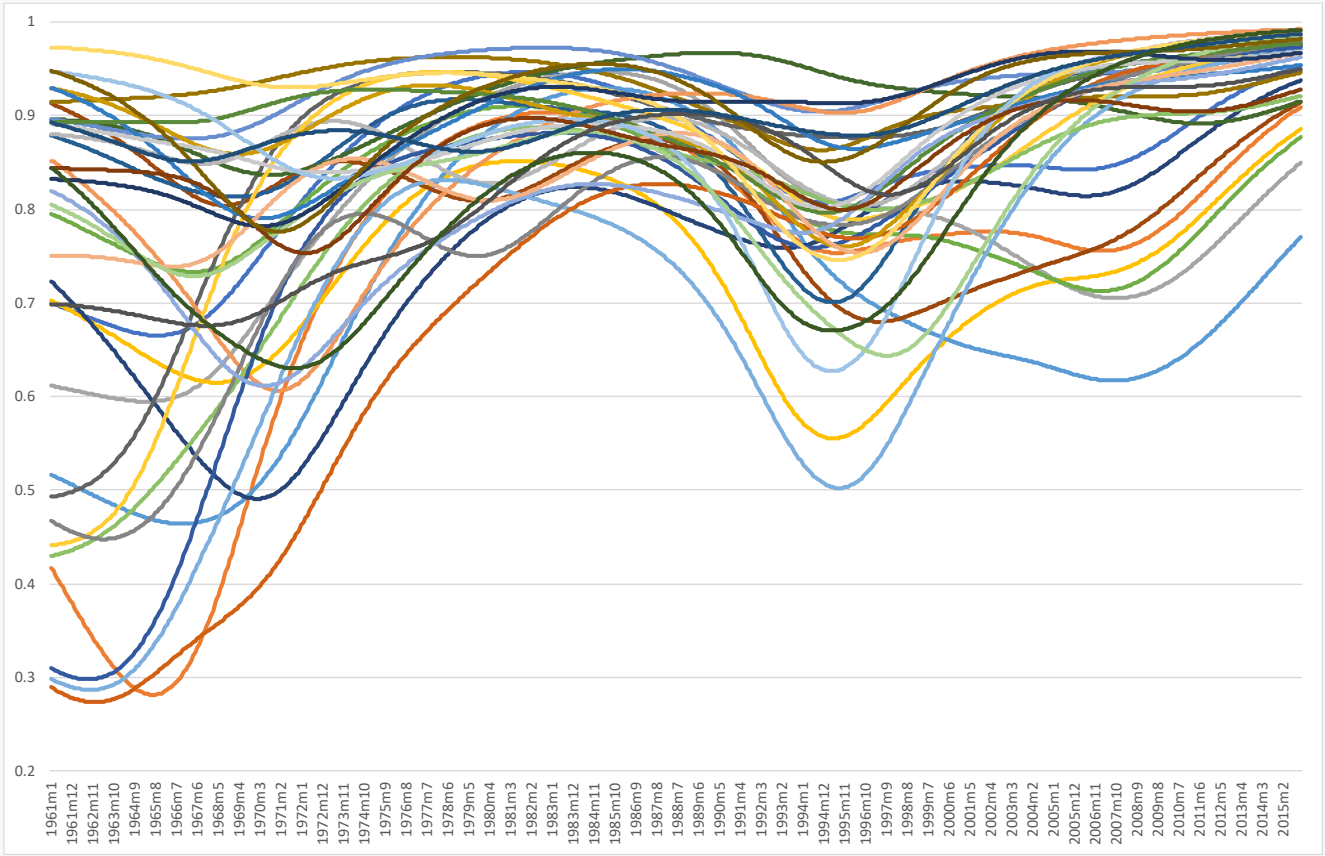

WTC: Burgenland-Vienna
WTC: Burgenland-Vorarlberg
WTC: Carinthia-Lower Austria
WTC: Lower Austria-Upper Austria
WTC: Lower Austria-Vienna
WTC: Lower Austria-Vorarlberg
Period (months)
4
8
16
32
64
128
1960M12
1977M08
1994M04
2010M12
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Heterogeniety

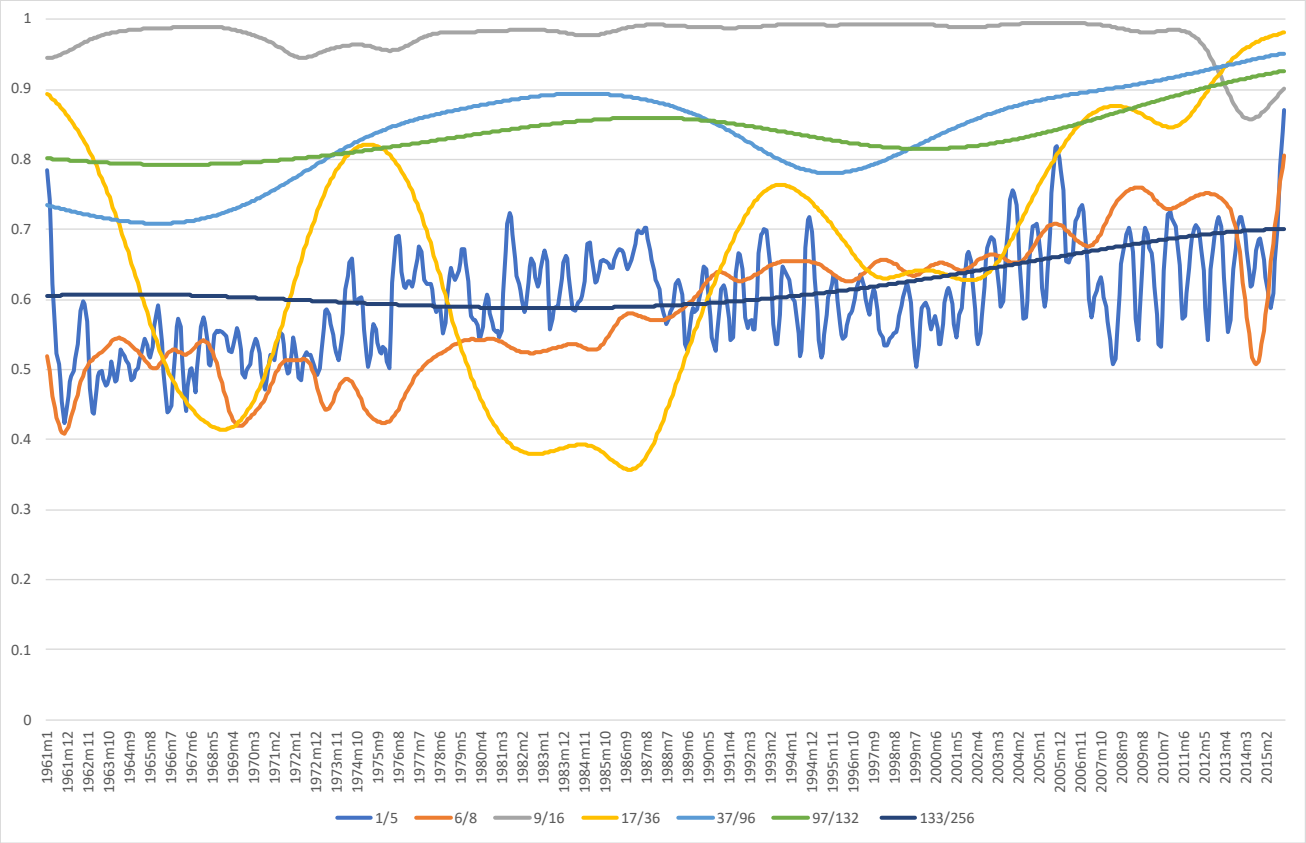
Questions

- Q1: at which frequencies is co-movement highest?
- Q2: Did heterogeneity across pairs change?
- Q3: How much of the variance to region, and time fixed effects explain

Coherence unemployment rate at long business cycle frequency



Average co-movement over pairs
(by frequeny over time, unemployment)



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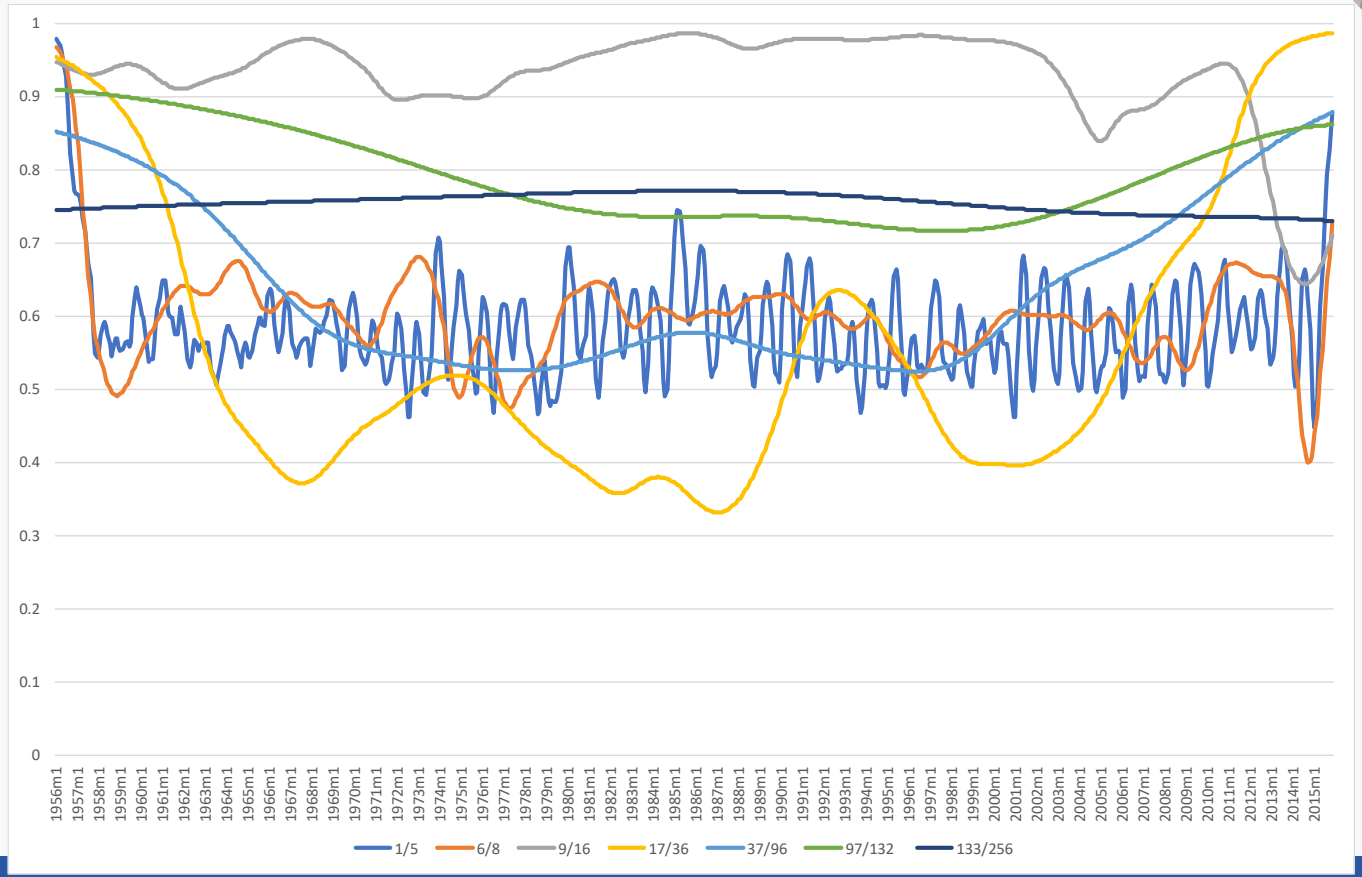
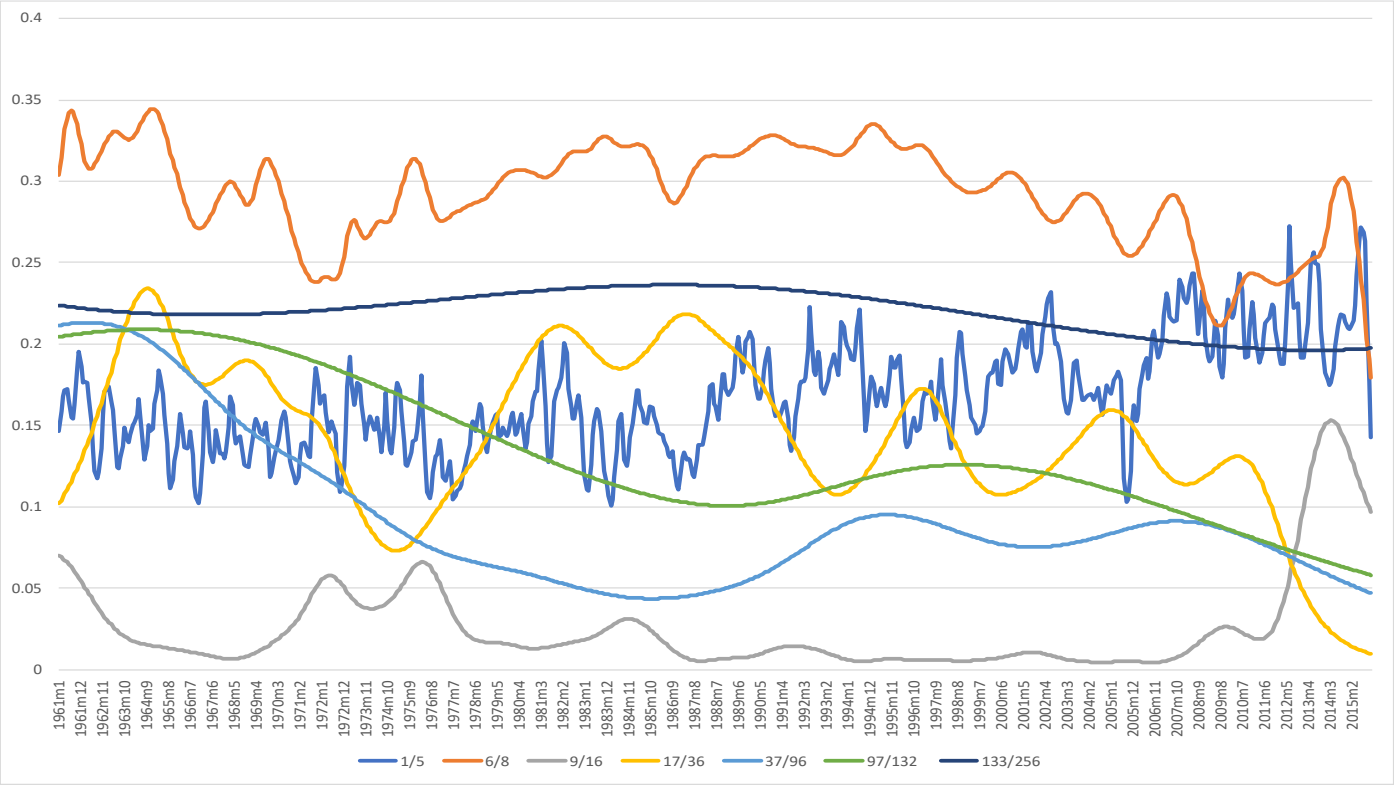


Variance across pairs (sigma-convergence): Unemployment Rate



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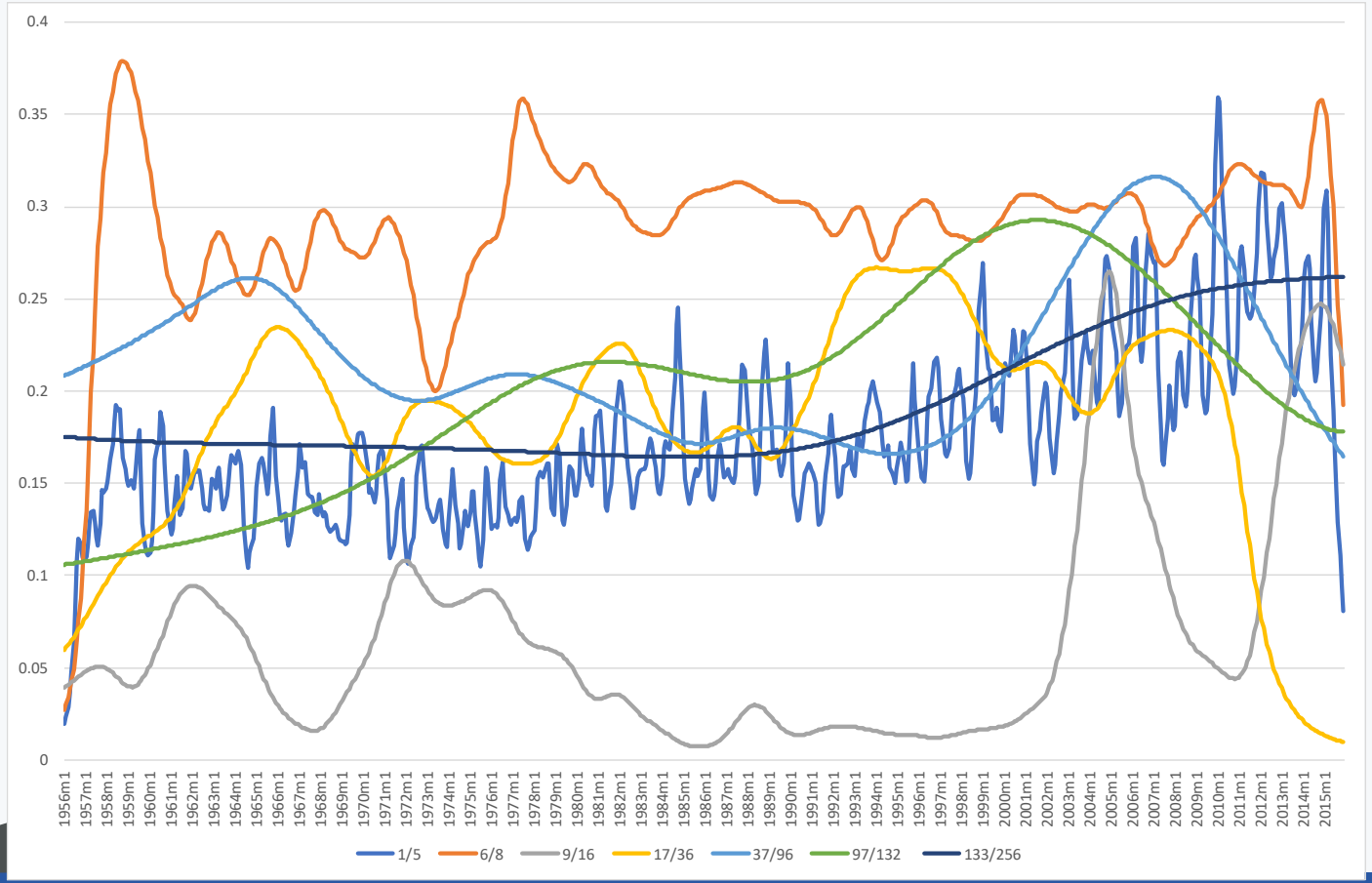
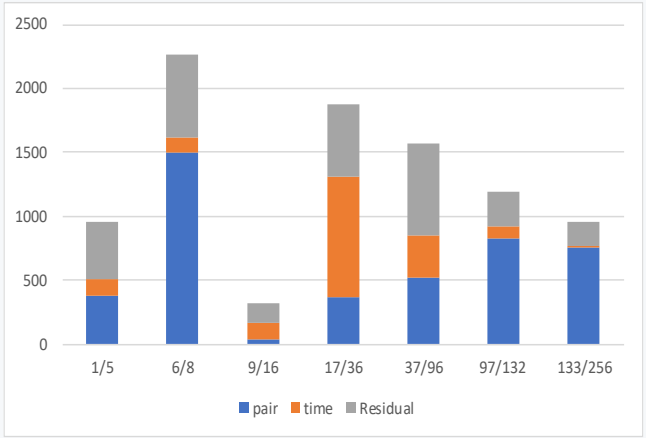
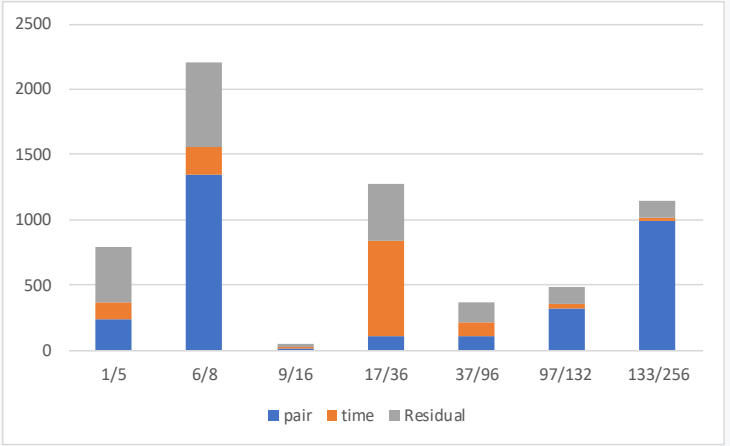


Sources of Variance (ANOVA Results)

Employment



Unemployment



Trends

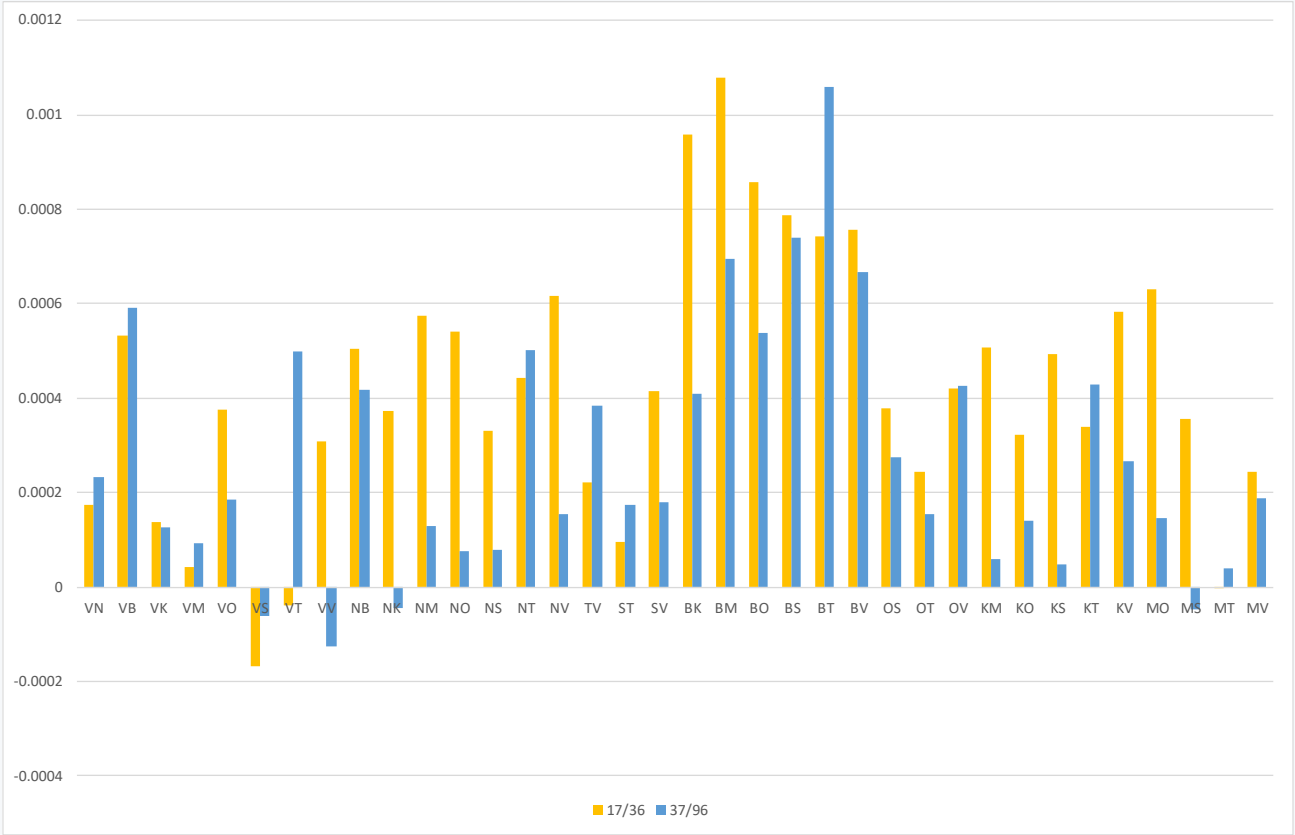
Questions

- Q1: Is there a general tendency for coherence to increase
- Q2: does this apply to all region pairs to the same extent?
- Are there differences across periods

Panel Trend Regression
(control for region fixed effects)

Frequency	Noise (1-5 Months)	Seasonal short (8-6 Months)	Seasonal short (9-16 Months)	BC short (17-36 Months)	BC short (37-96 Months)	Juglar Cycles (97-132 Months)	Long Cycles (133-256 Months)
				Unemployment			
Trend	0.00022	0.00043	-0.00002	0.00042	0.00027	0.00014	0.00014
	(43.15)	(73.31)	(13.32)	(59.79)	(88.09)	(51.07)	(54.89)
N	23760	23760	23760	23760	23760	23760	23760
R-sq	0.073	0.185	0.007	0.131	0.246	0.099	0.113
				Employment			
Trend	-0.00003	-0.00008	-0.00012	0.00013	0.00004	-0.00014	-0.00003
	(7.00)	(15.19)	(38.79)	(17.72)	(6.50)	(41.84)	(10.41)
N	25920	25920	25920	25920	25920	25920	25920
R-sq	0.002	0.009	0.055	0.012	0.002	0.063	0.004

Trends by region (unemployment)



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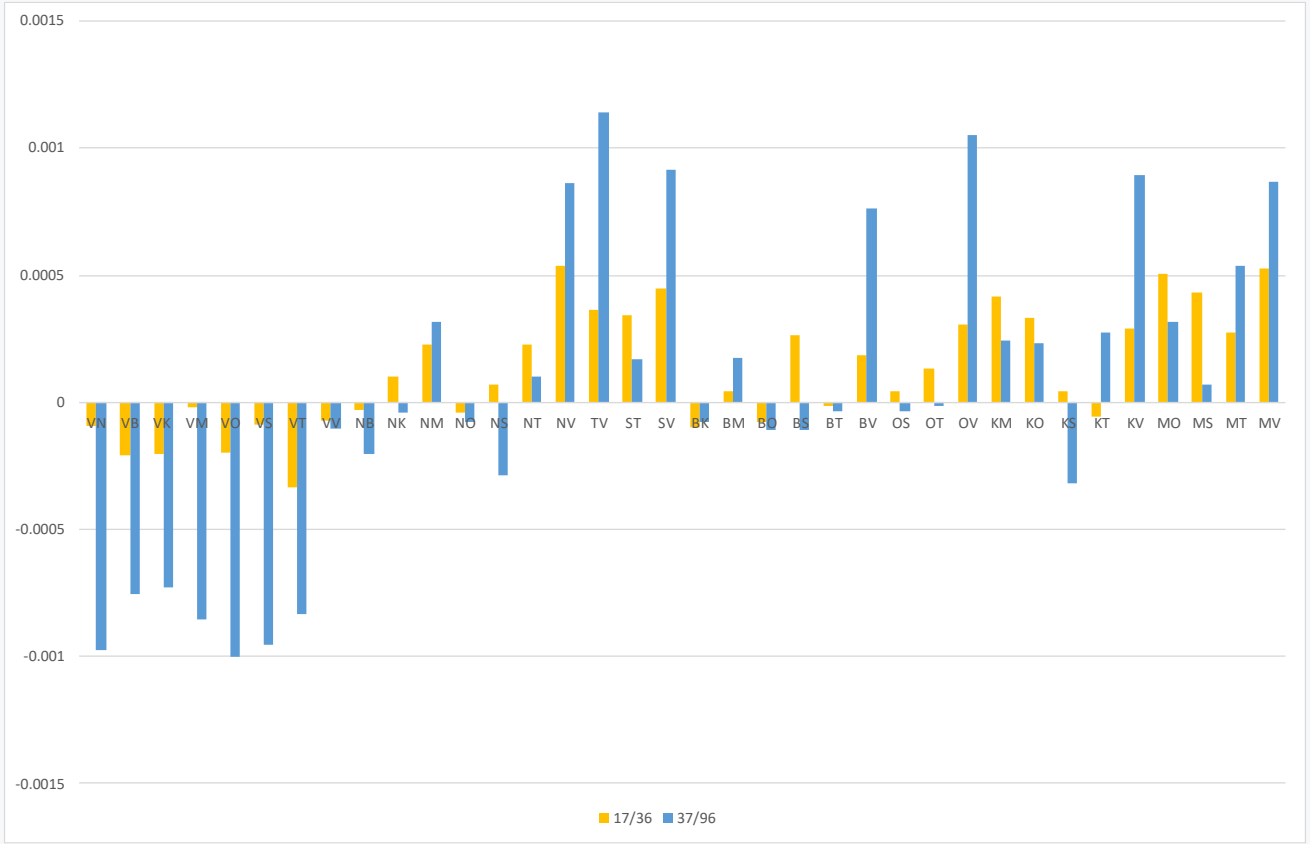
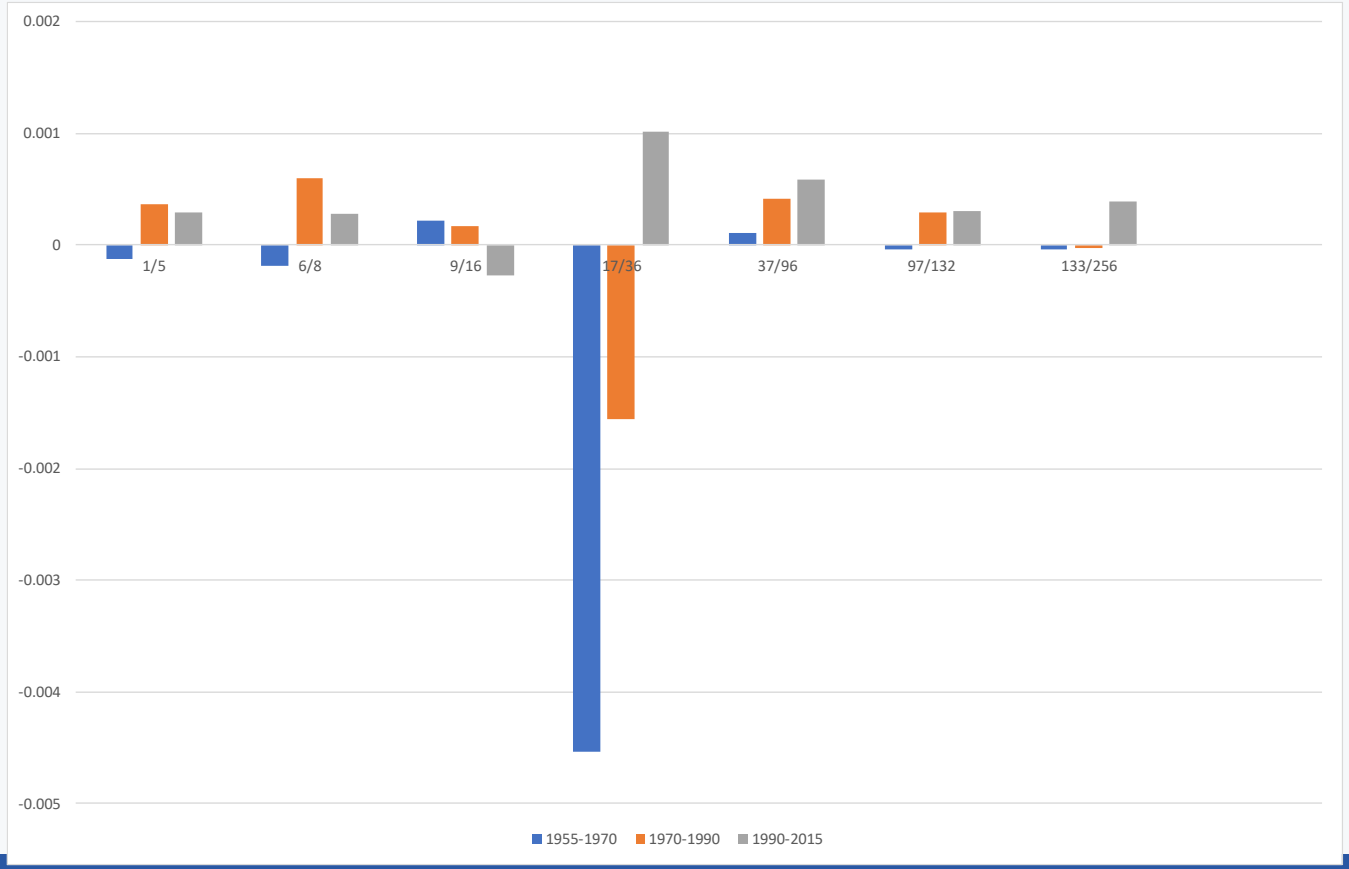


Regression coefficients of trend by time period (unemployment)



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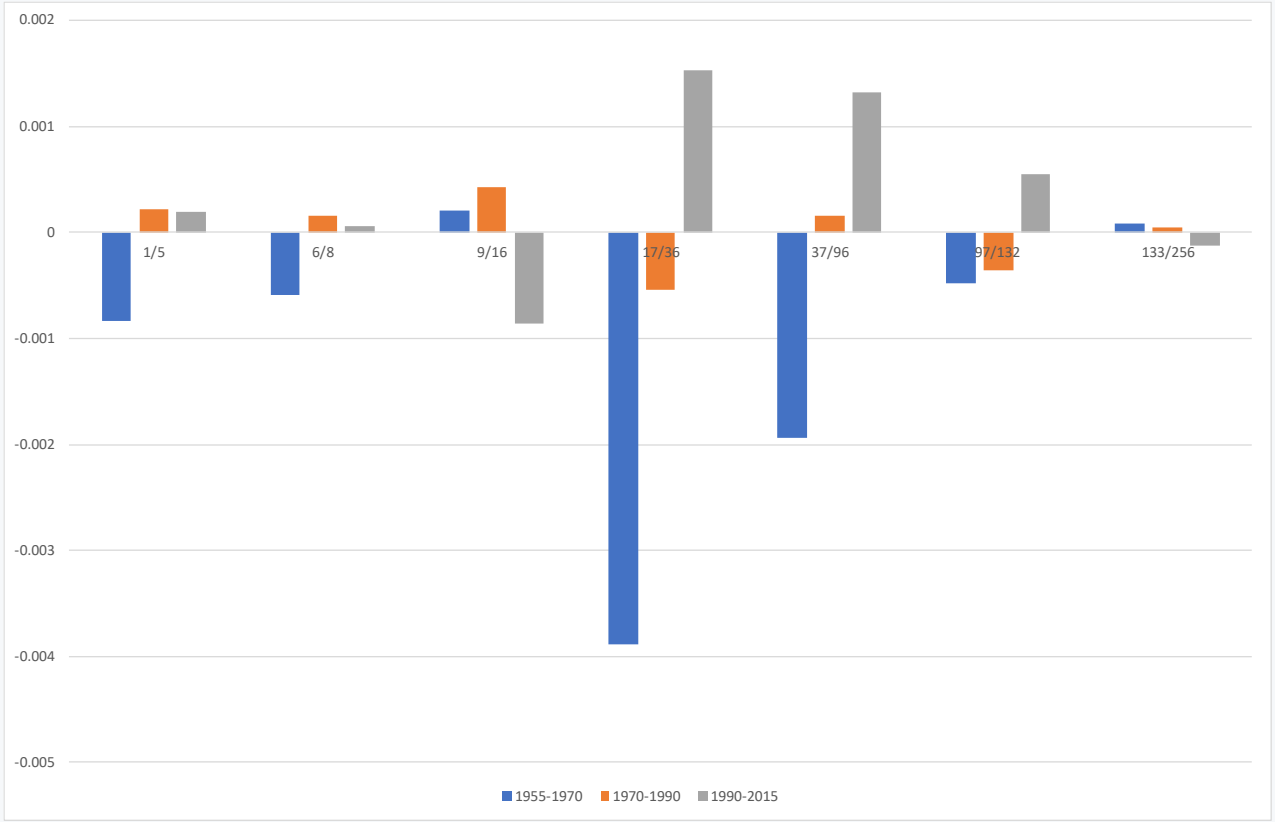

Correlates

- Explanatory variables
  - Employment structure
    - Difference in primary sector employment share
    - Difference in secondary sector employment share
    - Difference in tertiary sector employment share
    - Average Difference in sector employment shares ($\frac{1}{2}\sum_k |s_{ik} - s_{jk}|$)
  - Labour flows
    - In-commuting share (annual from1996, prior decennial 1961, 71 81, 91)
    - Out-communing share (annual from1996, prior decennial 1961, 71 81, 91)
  - Time invariant
    - ln(shortest road distance between capitals)
    - Neighbours

Regression Results 1

Frequency	Noise (1-5 Months)	Seasonal short (8-6 Months)	Seasonal long (9-16 Months)	BC short (17-36 Months)	BC short (37-96 Months)	Juglar Cycles (97-132 Months)	Long Cycles (133-256 Months)
				Unemployment			
Structural Difference	0.909	-0.747	0.060	-1.011	-1.521	-0.753	-1.097
	(11.910)	(8.560)	(3.170)	(13.850)	(43.180)	(19.370)	(26.520)
In-Commuting share	-0.565	0.829	0.092	1.471	0.446	-0.578	0.522
	(7.980)	(10.260)	(5.250)	(21.730)	(13.660)	(16.040)	(13.600)
Out-commuting Share	0.412	0.413	0.115	0.665	0.012	0.062	-0.298
	(7.530)	(6.600)	(8.470)	(12.690)	(0.490)	(2.240)	(10.030)
Time fixed effects	Y	Y	Y	Y	Y	Y	Y
Pair fixed effects	Y	Y	Y	Y	Y	Y	Y
N	21600	21600	21600	21600	21600	21600	21600
R-sq	0.215	0.277	0.416	0.671	0.524	0.207	0.236
				Employment			
Structural Difference	1.055	-0.542	0.865	-1.726	-2.701	-0.338	-1.980
	(14.250)	(7.140)	(18.690)	(20.050)	(33.440)	(7.130)	(41.480)
In-Commuting share	-0.457	0.847	-0.169	-0.160	1.062	0.856	0.960
	(6.650)	(12.020)	(3.940)	(2.000)	(14.170)	(19.480)	(21.670)
Out-commuting Share	0.088	-0.123	-0.093	0.605	1.674	0.108	0.570
	(1.660)	(2.260)	(2.790)	(9.800)	(28.900)	(3.180)	(16.650)
Time fixed effects	Y	Y	Y	Y	Y	Y	Y
Pair fixed effects	Y	Y	Y	Y	Y	Y	Y
N	21600	21600	21600	21600	21600	21600	21600
R-sq	0.186	0.126	0.467	0.578	0.378	0.260	0.125

Regression results 2

	Noise (1-5 Months)	Seasonal short (8-6 Months)	Seasonal long (9-16 Months)	BC short (17-36 Months)	BC short (37-96 Months)	Juglar Cycles (97-132 Months)	Long Cycles (133-256 Months)
				Unemployment			
Secondary Sector Difference	0.285	0.668	-0.128	-0.408	-0.368	-0.152	0.478
	(12.850)	(18.380)	(22.150)	(19.330)	(30.090)	(8.860)	(17.340)
Tertiary Sector difference	1.398	6.539	-0.775	-2.861	-4.950	-3.912	2.557
	(8.060)	(24.080)	(17.740)	(18.110)	(51.180)	(21.300)	(12.830)
In-Commuting share	-0.785	0.535	-0.092	0.844	0.502	-0.314	0.013
	(15.730)	(9.750)	(10.270)	(20.890)	(24.850)	(11.890)	(0.460)
Out-commuting Share	-0.362	0.189	0.011	0.597	0.233	-0.490	-1.179
	(9.740)	(4.120)	(1.360)	(19.240)	(11.730)	(11.330)	(31.890)
Neighbor	0.125	0.237	0.006	0.013	0.017	0.059	0.084
	(45.710)	(49.590)	(10.510)	(5.200)	(14.210)	(28.080)	(27.950)
ln(Distance)	-0.055	-0.045	-0.012	-0.042	-0.009	-0.001	-0.144
	(24.760)	(12.490)	(18.250)	(20.540)	(8.140)	(0.630)	(53.810)
Time fixed effects	Y	Y	Y	Y	Y	Y	Y
Pair fixed effects	N	N	N	N	N	N	N
N	21600	21600	21600	21600	21600	21600	21600
R-sq	0.296	0.278	0.402	0.637	0.487	0.194	0.339
				Employment			
Secondary Sector Difference	0.133	0.895	-0.115	-0.946	-1.237	-1.291	-0.934
	(5.850)	(25.150)	(8.830)	(37.350)	(39.610)	(46.170)	(34.070)
Tertiary Sector difference	0.509	7.757	-1.316	-3.533	-4.360	-6.415	-7.897
	(2.930)	(28.170)	(15.530)	(18.580)	(16.790)	(27.660)	(43.380)
In-Commuting share	-0.737	0.397	-0.317	-1.289	-0.986	-1.418	-0.650
	(16.960)	(6.630)	(15.300)	(31.130)	(17.020)	(26.170)	(13.260)
Out-commuting Share	0.045	-0.498	0.142	0.376	0.413	-1.082	-0.234
	(1.210)	(9.280)	(9.200)	(8.300)	(10.790)	(23.870)	(4.050)
Neighbor	0.097	0.246	0.005	0.042	0.071	0.088	0.060
	(30.170)	(49.830)	(2.760)	(13.280)	(22.980)	(34.370)	(20.620)
ln(Distance)	-0.108	-0.008	-0.040	-0.052	-0.022	-0.039	-0.006
	(46.390)	(2.060)	(29.700)	(19.500)	(7.780)	(13.940)	(2.030)
Time fixed effects	Y	Y	Y	Y	Y	Y	Y
Pair fixed effects	N	N	N	N	N	N	N
N	21600	21600	21600	21600	21600	21600	21600
R-sq	0.285	0.205	0.44	0.525	0.332	0.351	0.227

Summary

- Heterogeneity
  - is large for almost all frequencies
  - is mainly related to time invariant region fixed effects for short and long frequencies, but by commen time effects for business cycle frequencies
  - co-movement at low and high frequencies is lower than at business cycle frequencies for regional employment while no such clear result appears in the unemployment
- Trends
  - There is some evidence of an upward trend in co-movement at most frequencies
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  - There are aslo some signs of a decoupelling of Vienna at business cycle frequencies for employment rates
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  - Out and in-commuting are mostly positively correlated
  - More distant regions have lower comovement and neighboring regions higher comovement at all frequencies

Thank You for Your Attention