Historical Decoupling in EU: Evidence from Time-Frequency Analysis

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Motivation

- the European Integration Process fosters the catching-up of lagging countries but at the same time forces for specialization of economic activities within the regions (Krugman, 1993)
- the discussion about the risk of asymmetric shocks at the regional level boosted after
  - the Eastern enlargement in the years 2004 and 2007
  - the European debt crisis since the end of 2009
  - the Brexit referendum and subsequent decoupling after the year 2016
- the recent financial crisis influenced the worldwide national business cycles in the last decade
  - it acted as a relatively symmetric shock affecting nearly all regions in a similar manner (Kose et al., 2012)
  - however, the medium-run and long-run impact of the financial crisis has become more diverse due to the varying transmission mechanisms and vulnerabilities among countries

Brief literature overview

- the optimum currency area theory (OCA theory) pioneered by Mundell (1961), theoretically supported and contributed by McKinnon (1963), Kenen (1969), Corden (1972), Mundell (1973a; 1973b), Krugman (1993), Bayoumi and Eichengreen (1993) and Eichengreen (2007)
- the OCA theory is empirically tested by cyclical synchronization of economic activity
- the OCA endogeneity hypothesis: a single currency adoption increases trade integration endogenously as a result of transaction costs and exchange rate risk elimination (Frankel and Rose, 1998)
- countries with close international trade linkages would benefit from a common currency and are more likely to be members of the OCA

- the gravity models of international trade show a positive impact of a currency union on bilateral trade of its members (Rose, 2000; Frankel and Rose, 2002; Rose and Wincoop, 2001; Persson, 2001; Glick and Rose, 2002; Melitz, 2004 etc.)
- the correlation of business cycles of countries that are part of a currency area confirms the validity of the endogeneity hypothesis (Rose and Engel, 2002; Alesina et al., 2002; Tenreyro and Barro, 2007)
- important role of intra-industry trade in the process of trade integration and the convergence of cycle synchronization (Fontagné and Freudenberg, 1999; Fidrmuc, 2004)

- the OCA specialization hypothesis: increased trade within a common currency area might lead to industrial specialization between regions that have a comparative advantage, i.e. closer bilateral trade could result in looser cycle synchronization (Krugman, 1993)
- members of a currency area would become less diversified and more vulnerable to asymmetric shocks (Bayoumi and Eichengreen, 1993 and 1997; Frenkel et al., 1999; Babetski et al., 2002; Fidrmuc and Korhonen, 2003; Frenkel and Nickel, 2005; Eichengreen, 2007 etc.)

- main empirical approaches of cyclical synchronization:
  - static correlation analysis and its extensions (Engle and Kozicki, 1993), common cycles and codependence (Vahid and Engle, 1993 and 1997), and approaches based on sigma convergence methods (Crespo Cuaresma et al, 2013a and 2013b)
  - frequency domain techniques based on spectral and cross-spectral analysis based on coherency, squared coherency (denoted as coherence), dynamic correlation and phase shift methods (Croux et al., 2001; Iacobucci, 2003; Iacobucci and Noullez, 2005; Messina et al., 2009; Fidrmuc and Korhonen, 2010; Marczak and Beissinger, 2012; Fidrmuc et al., 2013)
  - time-frequency analyses provide a time-varying measure of synchronisation over different sub-periods (Crowley, 2007; Crowley and Mayes, 2008; Woźniak and Pacziński, 2007; Ge, 2008; Rua, 2010; Aguiar-Conraria and Soares, 2011; Hughes-Hallett and Richter, 2011; Jiang and Mahadevan, 2011; Maršálek et al., 2014; Verona, 2016; Alouis et al., 2016)

Contribution

- we apply frequency domain techniques to assess the dynamic properties of time series and their co-movement including phase shift enabling to identify spillover effect directions and asymmetries of business cycle shocks of causal relationships
- we investigate economic cycle comovements across the European Union after twenty years from euro adoption
- we identify the historical decoupling of heavily-indebted countries in Southern Europe and the UK economy
- our findings contradict the some of the conclusions of the endogeneity hypothesis as more open economies either (1) have not shared a common currency or (2) have not synchronised their business cycles with other EU countries.

Data

- fluctuations in economic activity representing by unemployment rate in 24 European countries, Russian Federation, and the United States
- monthly frequency in the period 1983M01-2016M12
- non-seasonally adjusted data are used because the frequency analysis allows to eliminate seasonal frequencies
- the average unemployment rate (Fatas, 1997) in the selected groups of European countries is weighted by the number of total population
- datasources: Eurostat, Federal Reserve Economic Database

Time-scale transformation

- we apply Continuous Wavelet Transform (CWT) as a band pass filter to time series $(x_n, n = 1, ..., N)$ with uniform time steps δt, where the time step is defined as the convolution of x_n with the scaled and normalized wavelet
- wavelet power is defined as $|W_n^X(S)|^2$ (Grinsted, 2004) and:

$$W_n^X(x) = \sqrt{\frac{\delta t}{S}} \sum_{n'=1}^{N} x'_n \Psi_0 \left[(n' - n) \frac{\delta t}{s} \right]$$

where s represents scale in time

- to localize a function in frequency and time we use Morlet wavelet Ψ_0 which provides an optimal tradeoff between both time and frequency localization (Teolis, 1998):

$$\Psi_0(\eta) = \pi^{-1/4} e^{i\omega\eta} e^{-1/2\eta^2}$$

where $\omega_0 = 6$ is dimensionless frequency and $\eta = x \times t$ is dimensionelss time by varying its scale s

Comovement

- to identify common time-localized oscillations in nonstationary time series (comovement/correlation) we apply Wavelet Coherence (WTC) of time series x_n and y_n as:

$$R^2(s) = \frac{|S\left(s^{-1}W_n^{XY}(s)\right)|^2}{S\left(s^{-1}|W_n^X(s)|^2\right) \times S\left(s^{-1}|W_n^Y(s)|^2\right)}$$

  where smoothing operator S is defined as $S(W) = S_{scale}(S_{time}(W_n(s)))$. S_{scale} and S_{time} represent smoothing operators along the wavelet scale axis and in time.

- to identify shocks in co-movements between the analysed time series x_n and y_n we apply the Cross Wavelet Transform (XWT):

$$W^{XY}(s,t) = W^X(s,t)W^{Y*}(s,t)$$

  where $*$ denotes complex conjugation (Grinsted, 2004)

Causality direction

- we applied phase shift to identify a time offset between the reflection and the maximum value on the waveform
- we interpret phase shift as a lead or a lag between time series
- following Grinsted (2004) we estimate the mean and confidence interval of the phase difference. The mean phase calculation is based on the circular mean of a set of angles $(a_i, i = 1, ..., n)$:

$$a_m = arg(X, Y)$$

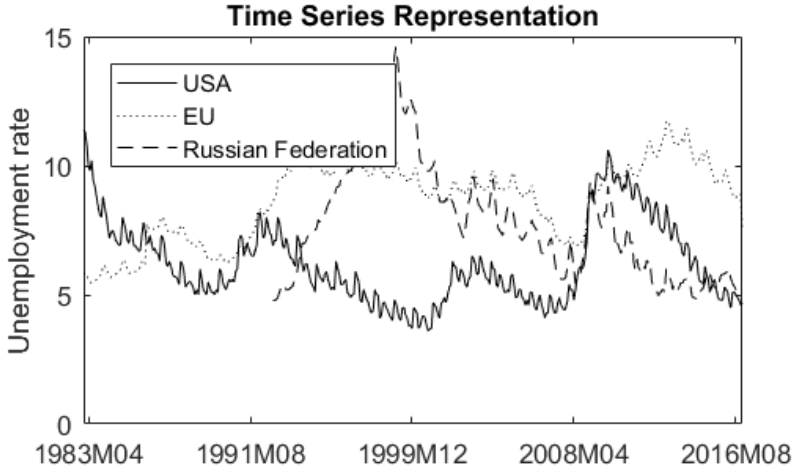
where $X = \sum_{i=1}^{n} cos(a_i)$ and $Y = \sum_{i=1}^{n} sin(a_i)$

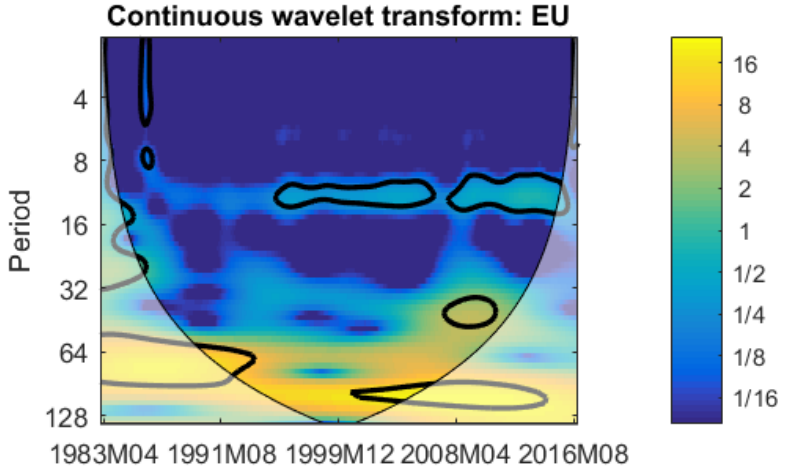
- we estimated statistical significance against an autocorrelation model with lag 1 and error term represented as white noise (Torrence and Compo, 1998)

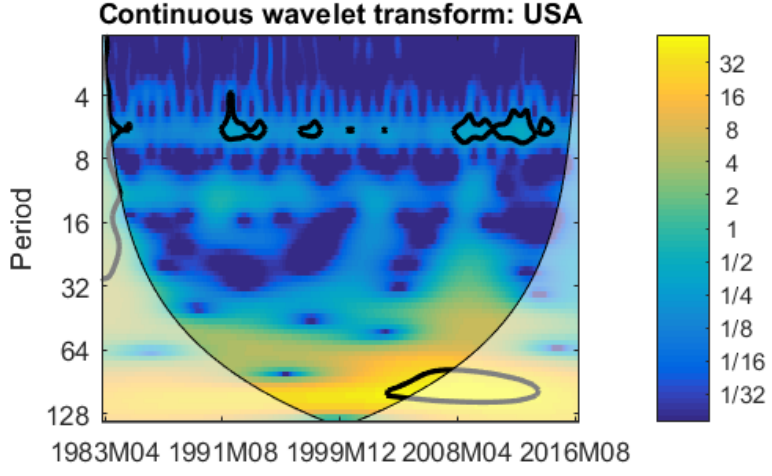
Trade openness

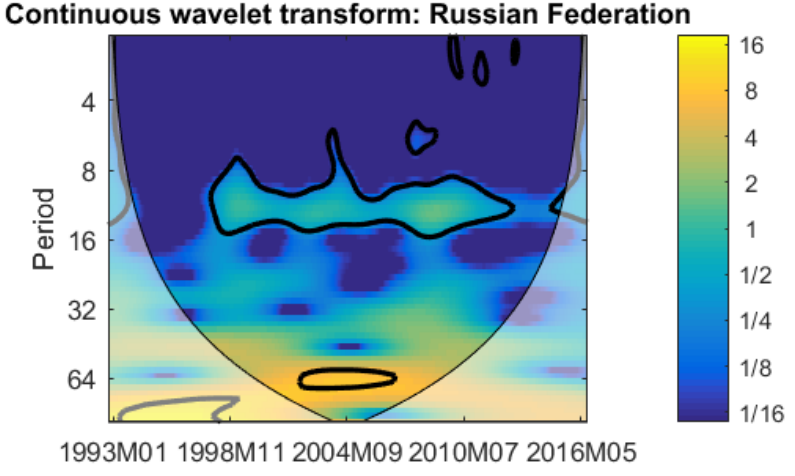
Country Name	1983-1998	1999-2016	% change	Country Name	1983-1998	1999-2016	% change
Hungary	0.73	1.47	1.00	Sweden	0.63	0.84	0.34
Poland	0.45	0.78	0.71	Lithuania	0.92	1.23	0.33
Germany	0.45	0.74	0.64	Italy	0.40	0.52	0.31
Czech Republic	0.78	1.24	0.58	Slovenia	0.95	1.24	0.31
Ireland	1.17	1.76	0.51	France	0.43	0.55	0.27
Malta	1.76	2.63	0.50	Belgium	1.18	1.49	0.26
Slovak Republic	1.07	1.52	0.43	Netherlands	1.06	1.33	0.26
Greece	0.40	0.56	0.41	Croatia	0.68	0.83	0.22
Spain	0.41	0.57	0.40	Latvia	0.86	1.02	0.19
Romania	0.53	0.75	0.40	Portugal	0.60	0.69	0.15
Austria	0.68	0.95	0.39	United Kingdom	0.49	0.55	0.12
Denmark	0.68	0.93	0.37	Cyprus	1.13	1.18	0.04
Finland	0.56	0.75	0.35	Estonia	1.47	1.42	-0.04

Time and Frequency Domain representation

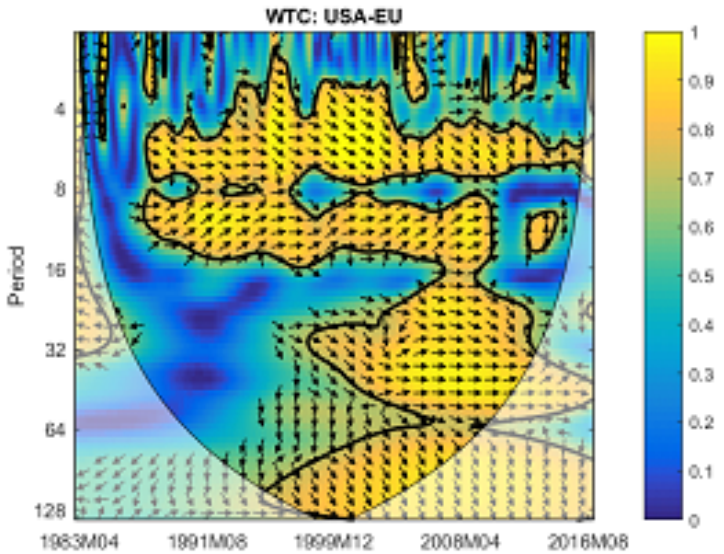


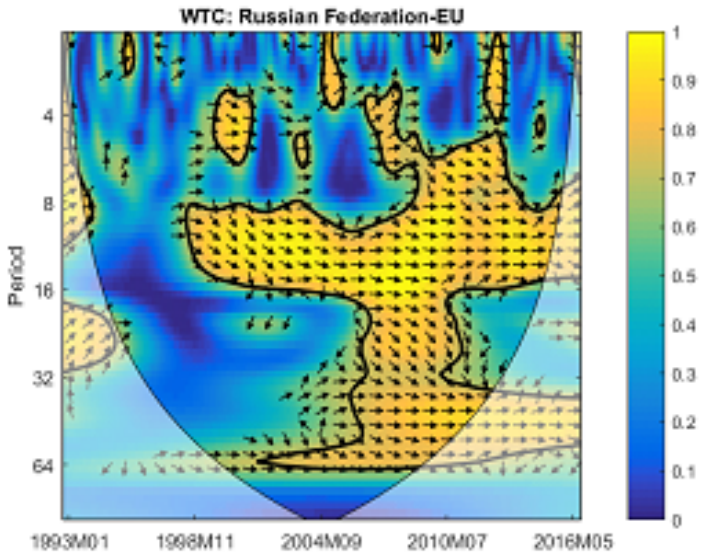


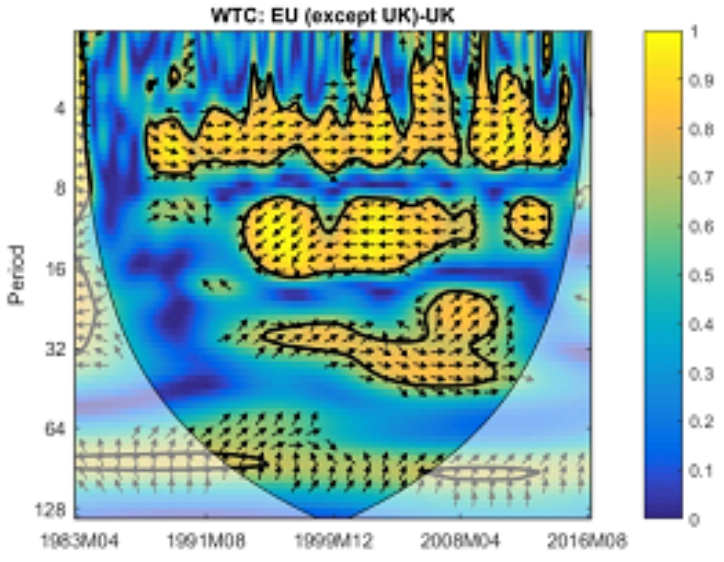




Wavelet Coherence






WTC: EU (except UK)-UK
Period
4
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128
1983M04
1991M08
1999M12
2008M04
2016M08
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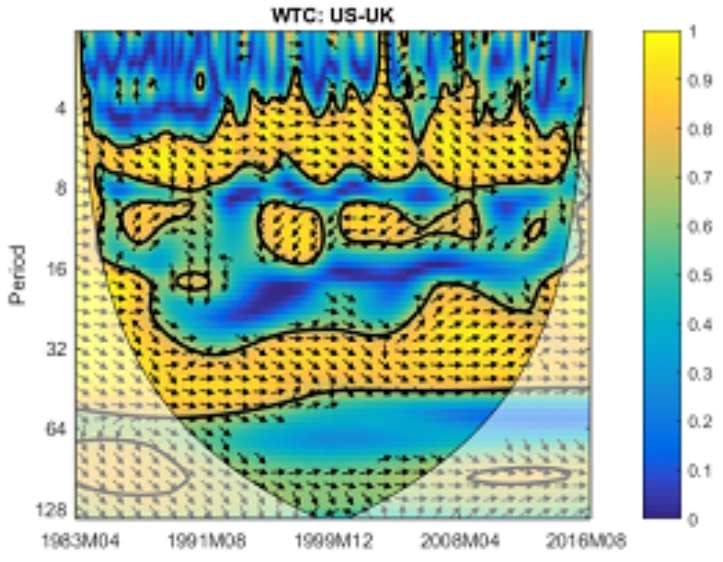
WTC: US-UK
Period
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1983M04
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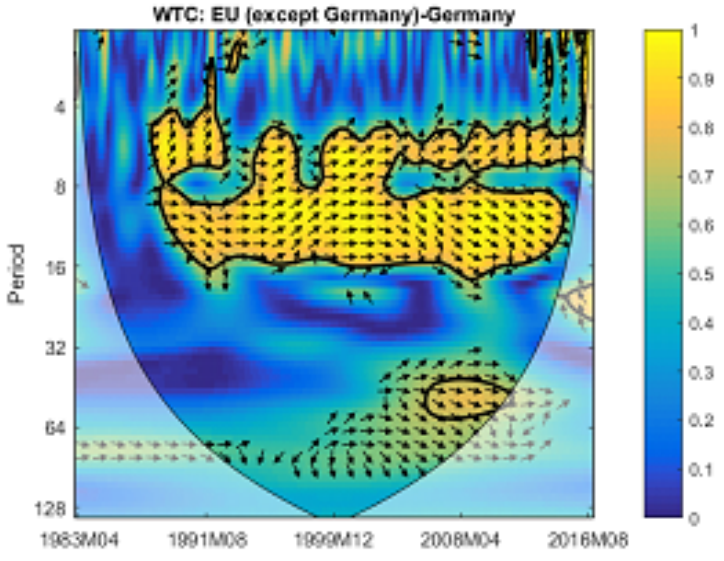
WTC: EU (except Germany)-Germany
Period
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1983M04
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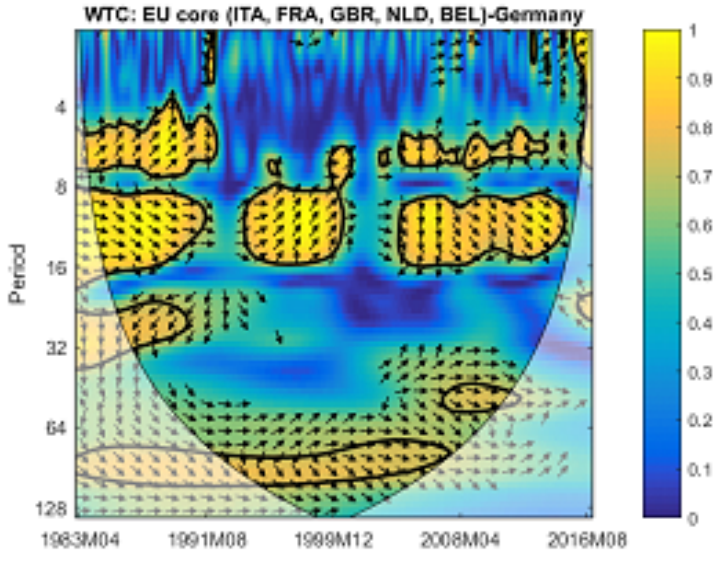
WTC: EU core (ITA, FRA, GBR, NLD, BEL)-Germany
Period
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1983M04
1991M08
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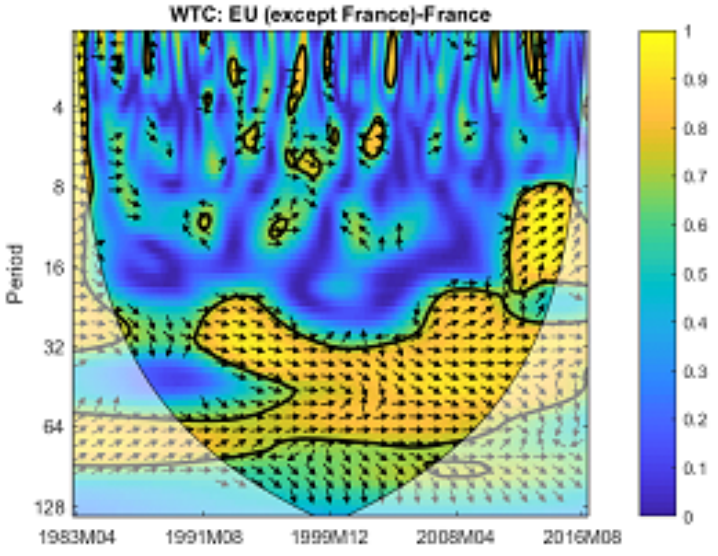
WTC: EU (except France)-France
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1983M04
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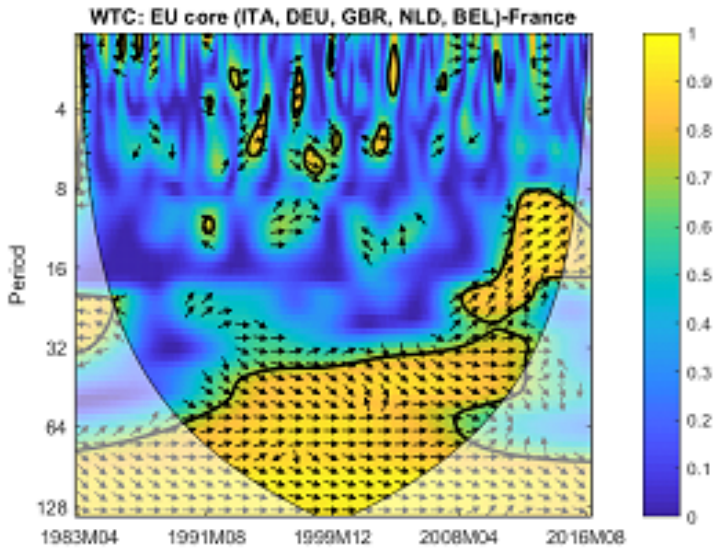
WTC: EU core (ITA, DEU, GBR, NLD, BEL)-France
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1983M04
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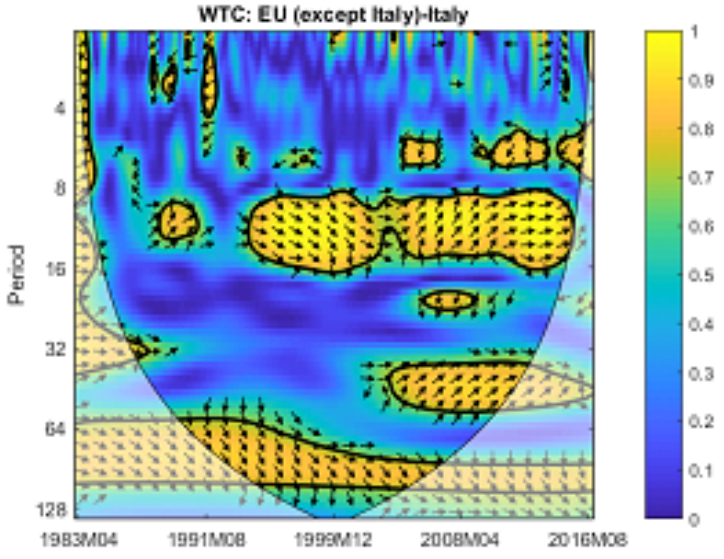
WTC: EU (except Italy)-Italy
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1983M04
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1999M12
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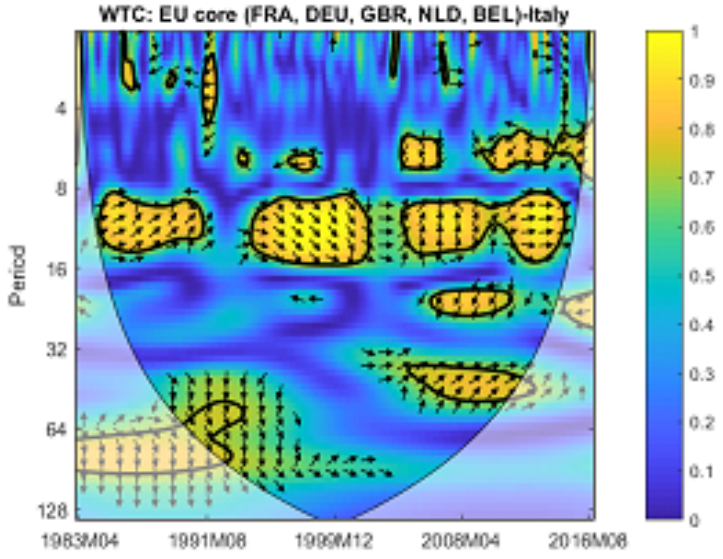
WTC: EU core (FRA, DEU, GBR, NLD, BEL)-Italy
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1983M04
1991M08
1999M12
2008M04
2016M08
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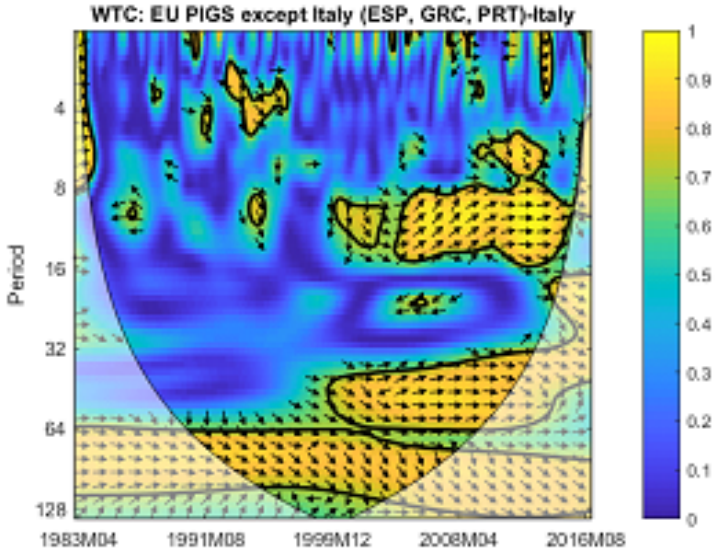
WTC: EU PIGS except Italy (ESP, GRC, PRT)-Italy
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1983M04
1991M08
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2008M04
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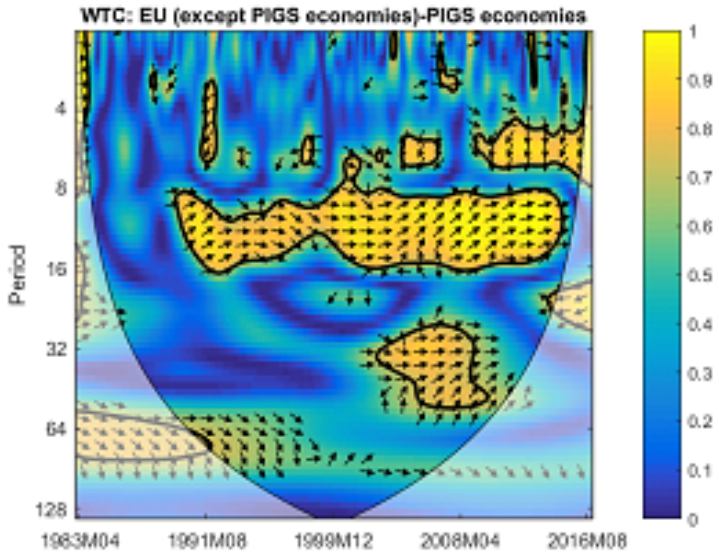
WTC: EU (except PIGS economies)-PIGS economies
Period
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1983M04
1991M08
1999M12
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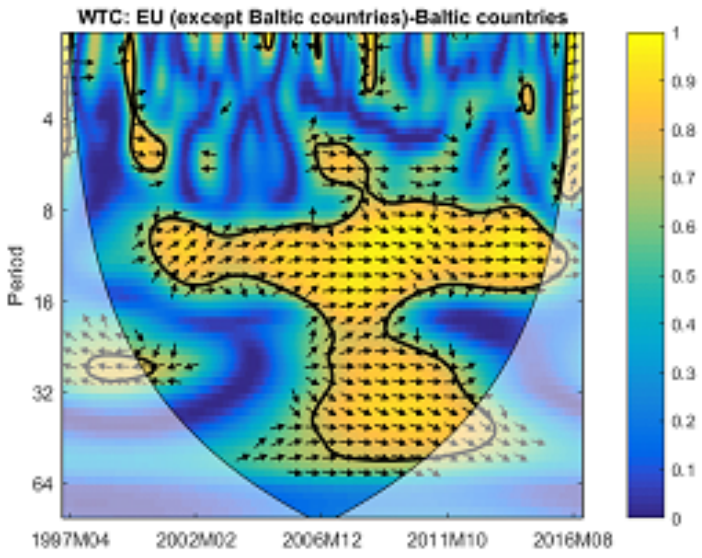
WTC: EU (except Baltic countries)-Baltic countries
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1997M04
2002M02
2006M12
2011M10
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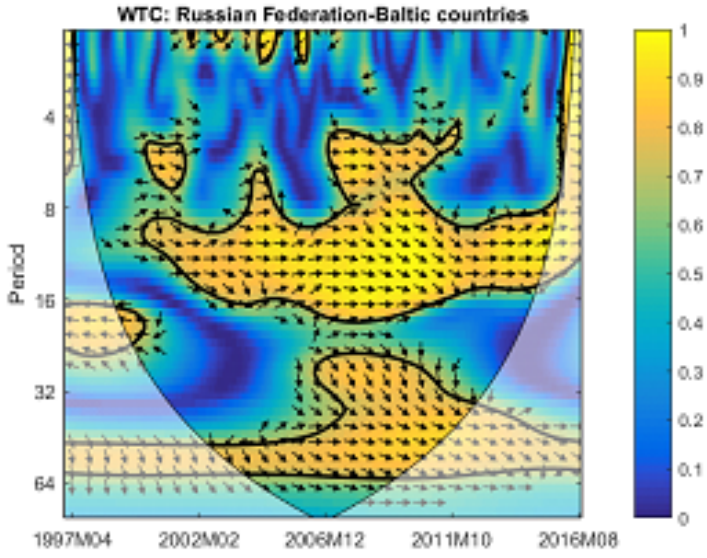
WTC: Russian Federation-Baltic countries
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1997M04
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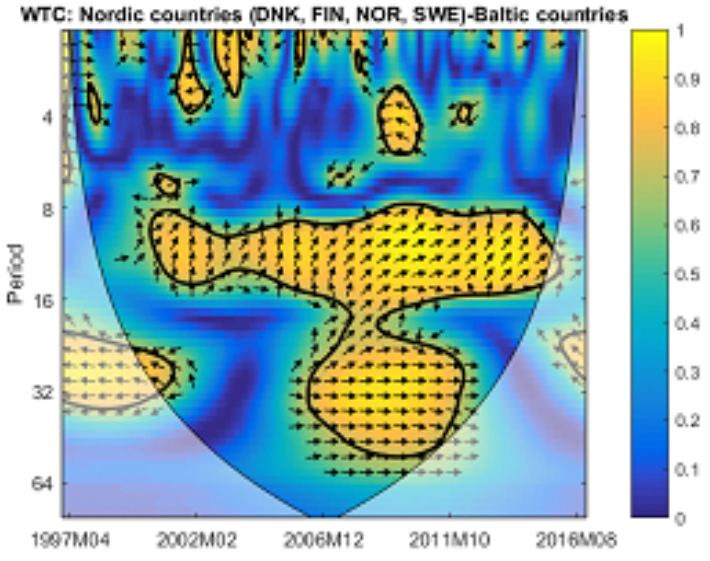
WTC: Nordic countries (DNK, FIN, NOR, SWE)-Baltic countries
Period
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1997M04
2002M02
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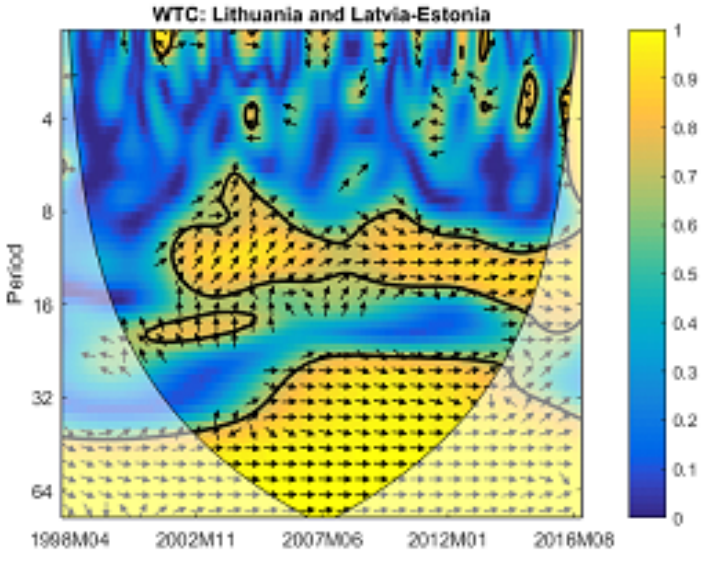
WTC: Lithuania and Latvia-Estonia
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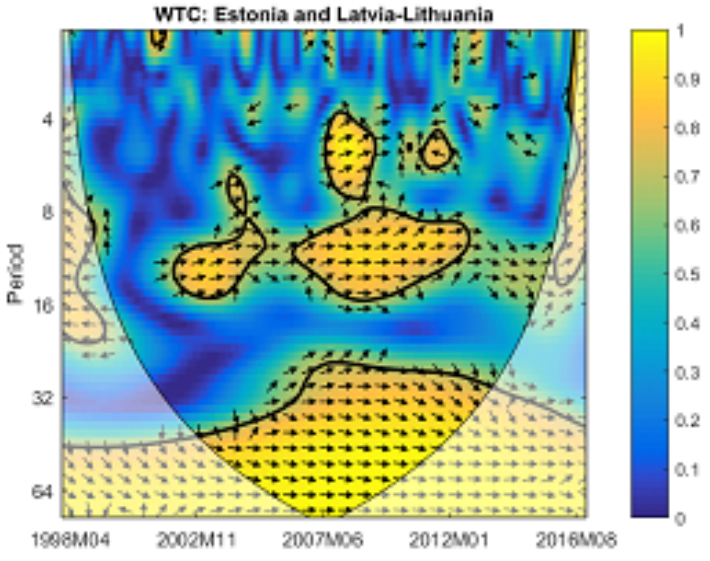
WTC: Estonia and Latvia-Lithuania
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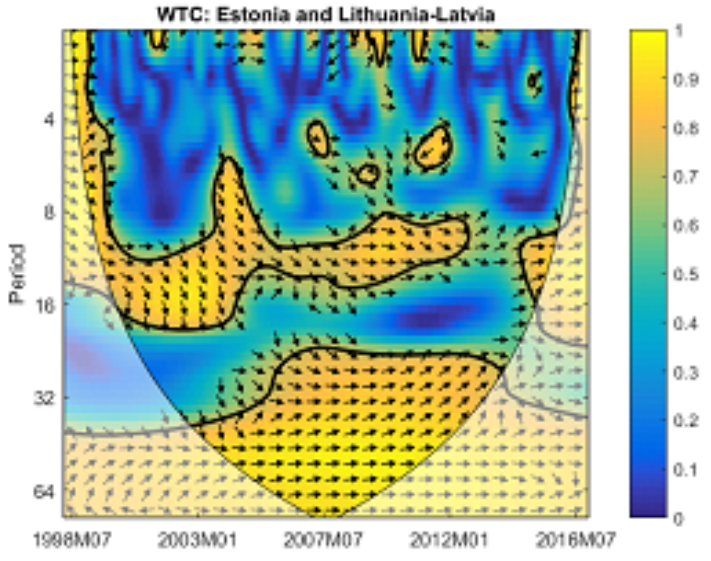
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Period
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2003M01
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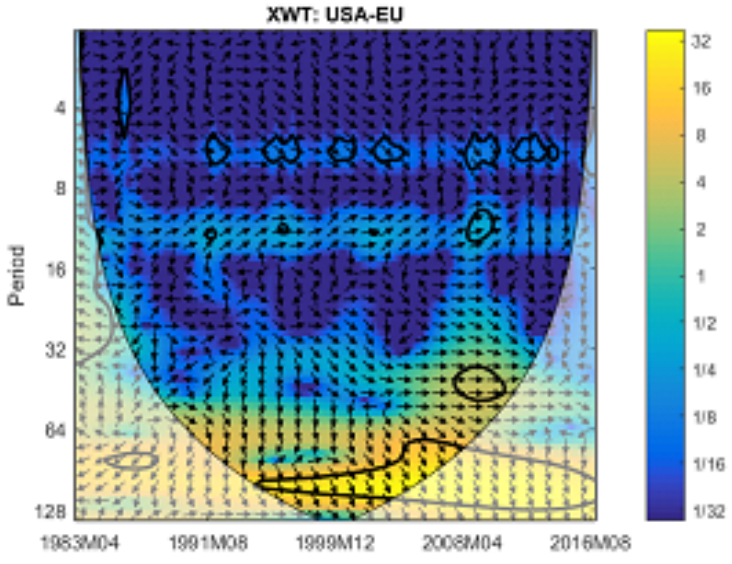
XWT: USA-EU
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1983M04
1991M08
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2016M08
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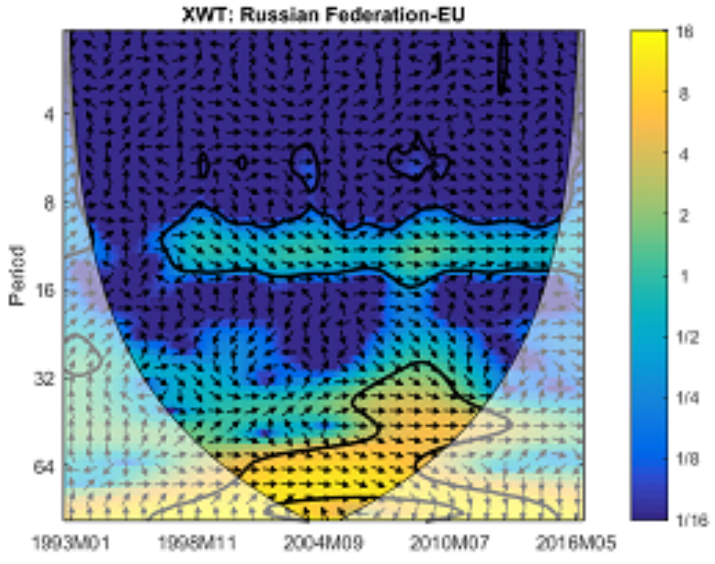
XWT: Russian Federation-EU
Period
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64
1993M01
1998M11
2004M09
2010M07
2016M05
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Discussion and Conclusions

- Italy and France are experiencing a lower increase in the trade openness even though our further results confirm that these countries have more synchronised business cycles with the EU than Germany or the Visegrad Group countries (which have not adopted the euro yet) with comparatively higher changes of trade openness
- we confirmed that the EU region faces the problem of worsened synchronization and the process of the decoupling of Germany, the UK and the southern countries particularly in the period after the financial crisis
- we also identify the important role of France as a country with a more synchronized business cycle with the EU countries compared to Germany (due to the different domestic economic policies)

- long-term cycle synchronization between Italy, France and the EU (and the other southern European countries) is change historically considered EU-core
- we find that the Baltic countries represent a single economic area and share common shocks
- the existence of the decoupling process of the UK economy from the EU economy before 1995 and after 2009 together with a strong and significant in-phase comovement with the US throughout the whole period
    - thus, the Britain's decision to leave the EU is not as unexpected as it may seem because it's economic background

Thank you for your attention . . .

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