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REAL EFFECTIVE EXCHANGE RATE AND UNEMPLOYMENT ACROSS POST-TRANSITION EUROPE: EVIDENCE FROM WAVELET COHERENCE ANALYSIS

Abstract

Purpose: The aim of this paper is to examine the co-movement between the real effective exchange rate and unemployment across post-transition Europe.

Methodology: The research data sample in this paper consists of monthly data from 2000M1 to 2019M6 for ten European post-transition countries. After standard correlation analysis, the research followed a wavelet coherence approach, provided time-series analysis in the time-frequency domain and illustrated evolution of the co-movements in the observed period.

Results: Conventional approach research results suggest no significant correlation between variables under consideration in cases of Poland and Lithuania. In cases of Latvia and Slovenia, standard correlation coefficients were positive and not in line with the theory. Correlation coefficients supported the theoretical assumption in six other countries included in the study. Wavelet coherence analysis results provided deeper insights into the relationship over time and the frequency domain. Empirical results gained in this research revealed a decline in the unemployment rate accompanied by depreciation of the real effective exchange rate as a prominent pattern at the beginning of the observation period suggesting pro-cyclical monetary policy.

Conclusion: During the crisis of 2008 no link between variables under consideration was confirmed, while after the crisis empirical results were in line with the theoretical assumption, suggesting that depreciation of the real effective exchange rate might be used as an instrument to boost employment.

Keywords: Correlation, wavelet coherence, unemployment, real effective exchange rate

1. Introduction

European post-transition countries experienced a large increase in unemployment during a recession following the 2008 financial crisis. Campolmi and Faia (2015) emphasize that currency fluctuations represent a prominent determinant of labor market dynamics. The countries of interest in this research are different in terms of exchange rate regimes. Bulgaria established the currency board, Estonia, Latvia, Lithuania, Slovakia, and Slovenia are members of the Euro Area, while Croatia, Czechia, Poland and Romania follow a flexible exchange rate regime, at least de jure (Slavov, 2017). Czechia and Poland implemented inflation targeting and Junicke (2017)

found them likely to target Producer Price Index (PPI) inflation rather than Consumer Price Index (CPI) inflation. Furthermore, flexibility of the nominal exchange rate is often considered crucial for the adjustment of the real exchange rate to purchasing power parity (Huang & Yang, 2015). As already stated, some of the sample countries are members of the European Monetary Union (EMU). To establish an equilibrium real exchange rate in the EMU countries, the asymmetric measures are required (Jiang et al., 2016). Therefore, this paper observes ten European post-transition countries and examines the interrelationship between the real effective exchange rate and unemployment. As further elaborated in the literature review section, the nature of a relationship might be ambiguous and cannot be assumed prior to empirical testing. When testing the existence and nature of the link, an increase and a decrease in the real effective exchange rate represent currency depreciation and appreciation, respectively. The relationship between the real effective exchange rate and unemployment was tested by using a conventional approach. Furthermore, this paper analyzes the country-specific relationship for ten European post-transition countries by taking into account potential changes in relation to time and frequency. Pentecost and Zarzosa Valdivia (2016) provide a literature overview pointing out the problem of endogeneity in the interrelationship between the real effective exchange rate and unemployment. Therefore, the real effective exchange rate might be a leading variable affecting the unemployment rate in a country or a lagging variable affected by the unemployment rate in a country. A wavelet coherence approach employed in this paper overcomes the issue and illustrates the relation that might be changing over the time and frequency domain.

The reminder of the paper is organized as follows: Section 2 briefly summarizes the existing literature related to the topic under consideration. Section 3 provides research data and the methodology employed, while Section 4 gives empirical results and discussion. The final section provides an overview of the main research findings.

2. Brief review of the related literature

The baseline theoretical model for this paper relies on the well-known Phillips curve that assumes a negative relation between inflation and unemployment in a country. Empirical literature has repeatedly questioned the Phillips curve in the last decades. However, this paper is focused on the relationship between unemployment and the real effective exchange rate as a more comprehensive measure of a country's competitiveness. Horváth and Magda (2018) examined the relationship between inflation and employment across European Union (EU) member countries and pointed out that the Philips curve has completely diminished nowadays. Based on the Phillips curve, D'Adamo and Rovelli (2015) illustrated that different labor market institutions across EU countries respond differently in terms of inflation to unemployment and exchange rate shocks. Schmitt-Grohé and Uribe (2016) pointed out that a currency peg and free capital mobility affect sovereign borrowing during periods of expansion and high unemployment rates during periods of contraction, respectively. Nucera (2017) examined the dynamics of unemployment and effects on exchange rate fluctuations pointing out that lower growth in the unemployment rate appreciates currency of a country, while higher growth in the unemployment rate causes currency depreciation. Devereux and Yu (2017) suggested that in normal times, alternative exchange rate policies do not affect the economy differently. However, in periods of crisis, the effects on the real economy were more adverse under a pegged exchange rate regime. Geerolf (2019) examined the Phillips curve under different exchange rate regimes and found that inflation and unemployment correlated negatively under fixed exchange rate regimes, whereas the relationship does not hold under flexible exchange rate regimes. However, the results pointed out a negative correlation between real exchange rate appreciation and unemployment under fixed and flexible rate regimes as well. Benazić and Rami (2016) employed the bounds testing approach and found that Croatian monetary policy is limited when it comes to reducing unemployment. Andor (2016) pointed out divergences developed within the euro area when considering common unemployment insurance as a possible measure to make the single currency sustainable. Mosteanu (2017) pointed out that pegging the currency to the euro increases investor confidence and consequently the level of investment in Bulgaria and Romania, which results in creating new job opportunities and decreasing the unemployment rate. Saadaoui (2018) examined peripheral countries of the EMU and pointed out that due to internal devaluations the peripheral countries have managed to reduce their exchange rate misalignments. Effects from the

real effective exchange rate to unemployment are often referred to in the literature as real exchange rate pass-through. Usman and Elsalih (2018) and references cited therein pointed out an ambiguous relationship between real effective exchange rates and unemployment. A consequence of real effective exchange rate depreciation are cheaper exports and more expensive imports. Hence, a country may increase the quantity of exports and production accompanied with increased employment. In the case of labor market rigidity and high bargaining power of employees, real depreciation of national currency might correspond with an increase in wages that reduce the earnings of companies. Real depreciation of the real exchange rate might have detrimental effects on a country's unemployment rate in the case of highly dollarized economies (Galindo et al., 2007). Some countries considered in this research joined the EMU within the period under study, whereas economies of others are highly dollarized (Bošnjak, 2018). Furthermore, there might be effects from unemployment to the real effective exchange rate as well. An increase in employment increases a country's productivity and consequently national currency appreciation. Hence, the relationship between real effective exchange rates and unemployment might be ambiguous and different over time as well as for individual countries. The empirical literature on the intersection between the real effective exchange rate and unemployment is scarce, especially for the group of countries considered in this paper. Furthermore, some of the sample countries are members of the EMU, while others are being considered for membership. Stoupos and Kiohos (2017) analyzed conditions from the perspective of the single currency area and found that Croatia, Czechia, and Hungary are not ready to join the euro area, while Poland and Romania were already aligned with the euro fluctuations. The aim of this paper is to make a step forward towards filling a gap in the literature and shed some light on the relationship between the real effective exchange rate and unemployment in European post-transition countries.

3. Research data and methodology

The research data sample consists of monthly unemployment rate data expressed as a percentage of active population and the real effective exchange rate index (2010=100) for 19 trading partners (the euro area) from 2000M1 to 2019M6. The sample data were retrieved from Eurostat for ten European post-transition countries including Bulgaria, Croatia, Czechia, Estonia, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Unemployment trends are illustrated in Figure A1 in the Appendix, while descriptive statistics is summarized in Table 1.

Table 1 Descriptive statistics for the unemployment rate from 2000M1 to 2019M6

	Bulgaria	Czechia	Croatia	Latvia	Lithuania
Min.	4.4	1.7	5.9	5.1	3.7
1st qtr.	6.8	4.8	10.6	8.7	7.1
Median	10.4	6.8	13.6	11.2	10.7
Mean	10.6	6.2	13.1	11.5	10.8
3rd qtr.	12.8	7.7	15.4	13.8	13.8
Max.	20.7	9.6	19.5	21.5	19.1
	Poland	**Romania**	**Slovenia**	**Slovakia**	**Estonia**
Min.	4.7	3.7	4.0	5.3	3.9
1st qtr.	7.4	6.1	5.8	10.7	6.2
Median	9.0	6.8	6.6	13.8	8.6
Mean	9.8	6.6	6.9	13.5	9.1
3rd qtr.	12.2	7.4	8.1	17.2	11.4
Max.	17.9	9.5	11.3	20.2	19.7

Source: Author's calculation based on Eurostat data

As can be seen in Table 1, Croatia and Slovakia experienced the highest average unemployment rate in the period from 2000M1 to 2019M6, while Czechia and Slovenia recorded the lowest average unemployment rate in the said period. As illustrated in Table 1, the unemployment rate in other countries ranges between these values. Figure A2 in the Appendix illustrates the development of the real effective exchange rate index for 19 trading partners (the euro area). An increase in the real effective exchange rate and a decrease in the real effective exchange rate represent real depreciation and real appreciation, respectively. Table 2 provides descriptive statistics for the real effective exchange rate index for 19 trading partners (the euro area).

Table 2 Descriptive statistics for the real effective exchange rate (2010=100) from 2000M1 to 2019M6

	Bulgaria	Czechia	Croatia	Latvia	Lithuania
Min.	67.3	67.9	85.5	80.7	79.9
1st qtr.	79.0	82.0	93.3	89.9	88.4
Median	94.8	93.1	96.1	99.8	99.6
Mean	89.7	90.5	95.3	95.9	95.6
3rd qtr.	98.5	99.1	97.3	101.1	101.2
Max.	101.8	107.5	101.4	105.3	104.1
	Poland	**Romania**	**Slovenia**	**Slovakia**	**Estonia**
Min.	77.6	76.0	93.0	56.3	80.8
1st qtr.	92.1	87.0	95.4	74.0	87.4
Median	95.5	97.3	98.2	99.8	99.3
Mean	95.6	94.9	97.5	88.2	97.0
3rd qtr.	98.6	100.8	99.3	101.1	105.2
Max.	116.5	116.4	100.8	103.8	110.3

Source: Author's calculation based on Eurostat data

As illustrated in Table 2, the highest average real effective exchange rate index for 19 trading partners (the euro area) was recorded in Slovenia and Estonia, while the lowest average real effective exchange rate index for 19 trading partners from the euro area is recorded in Slovakia and Bulgaria. After data sample presentation and description, the research starts from an approach that is more conventional. Based on the research data presented in this section, the standard Pearson correlation coefficient between unemployment and the real effective exchange rate index for 19 trading partners from the euro area is calculated for each country. The Pearson correlation coefficient is calculated to enable a comparison of results obtained by using different approaches. The recent empirical literature in the fields of economics and finance recognized the advantages of a wavelet-based approach followed in this paper (Demir et al., 2020; Karabulut et al., 2020; Karabulut et al., 2020a; Rathinasamy et al., 2017; Rua, 2012; Vacha & Barunik, 2012; Xu, 2019). Unlike conventional approaches to time series analysis, a wavelet-based approach enables insights into time and frequency domains. The research in this paper employs the Morlet wavelet given in equation (1):

$$\psi^M(t) = \frac{1}{\pi^{\frac{1}{4}}} e^{i\omega_0 t} e^{\frac{-t^2}{2}}, \quad (1)$$

where t represents time and ω_0 is a central frequency controlling the number of oscillations set to six as is often the case in comparable economic studies (Vacha & Barunik, 2012). A complex Morlet wavelet is a valuable advantage allowing for a time-dependent amplitude and the phase for different frequencies. The continuous wavelet transform is presented in equation (2):

$$W_x(\tau, s) = \frac{1}{\sqrt{s}} \int_{-\infty}^{\infty} x(t) \psi\left(\frac{t-\tau}{s}\right) dt, \quad (2)$$

where $x(t)$, s and τ represent the observed time series, the scale and the location determining the po-

sition of the wavelet, respectively. Following wavelet transform equation (2), the observed time series $x(t)$ is decomposed in terms of wavelets. After that, the paper studies the size and significance of a local correlation between the real effective exchange rate and unemployment as two time series. Prior to examining the size and significance of a local correlation between the real effective exchange rate and unemployment as two time series, the cross wavelet transform and cross wavelet power need to be explained. The cross wavelet transform of two time series $x(t)$ and $y(t)$ is given in equation (3):

$$W_{xy}(\tau,s) = W_x(\tau,s)W_y(\tau,s)\,, \tag{3}$$

where $W_x(\tau,s)$ represents the continuous wavelet transform of the observed time series $x(t)$, and $W_y(\tau,s)$ denotes the complex conjugate continuous wavelet transform of the observed time series $y(t)$. Cross wavelet power is given as $|W_{xy}(\tau,s)|$. The squared wavelet coherence coefficient is presented in equation (4):

$$R^2(\tau,s) = \frac{\left|S\left(s^{-1}W_{xy}(\tau,s)\right)\right|^2}{S(s^{-1}|W_x(\tau,s)|^2)S\left(s^{-1}|W_y(\tau,s)|^2\right)}, \tag{4}$$

where S represents a smoothing operator. Just like the Pearson squared correlation coefficient, the squared wavelet coherence coefficient ranges from zero to one. Furthermore, wavelet coherence analysis provides phase differences between the considered time series. The wavelet coherence phase difference is provided in equation (5):

$$\varphi(\tau,s) = tan^{-1}\left(\frac{\Im\left(W_{xy}(\tau,s)\right)}{\Re\left(W_{xy}(\tau,s)\right)}\right), \tag{5}$$

where $\Re$ and $\Im$ represent the real part and the imaginary part of the cross wavelet transform in equation (3), respectively. A phase difference is illustrated by arrows. A zero phase difference indicates that the considered time series are positively correlated and move together. The arrows pointing right indicate a positive correlation, whereas the arrows pointing left represent a negative correlation. The arrows pointing up indicate that the first time series leads the second by the right angle, and the arrows pointing down indicate that the second time series leads the first by the right angle. Consequently, the arrows can indicate a combination of positions.

4. Empirical results and discussion

Based upon the empirical strategy defined in the section entitled Research data and methodology, the Pearson correlation coefficient (PC) and the corresponding p – values (p) are calculated firstly and the results are summarized in Table 3.

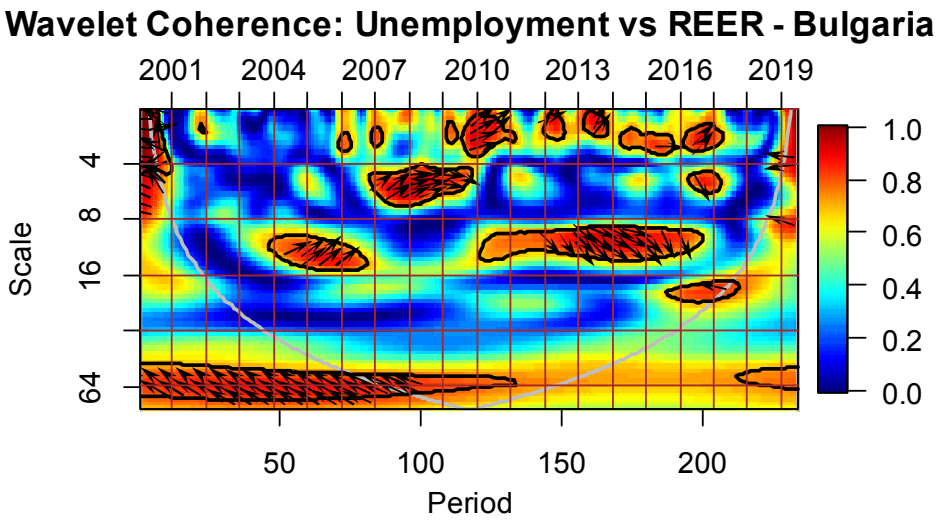
Table 3 Pearson correlation coefficient for the real effective exchange rate and unemployment

	Croatia	Czechia	Romania	Latvia	Lithuania
PC	-0.457	-0.619	-0.445	0.182	-0.118
p	0.000	0.000	0.000	0.005	0.072
	Estonia	**Bulgaria**	**Slovenia**	**Slovakia**	**Poland**
PC	-0.406	-0.633	0.369	-0.781	0.103
p	0.000	0.000	0.000	0.000	0.116

Source: Author's estimates

Following the results in Table 3 and holding significance at 5%, no significant correlation was found in the cases of Lithuania and Poland. Though with the difference in sign and magnitude, a significant correlation was found for other sample countries. In the cases of Latvia and Slovenia, the Pearson correlation coefficient was positive and not in line with theoretical assumptions, while in the cases of Croatia, Czechia, Romania, Estonia and Bulgaria, the correlation coefficient was negative. The highest degree of correlation was found in the cases of Slovakia, Bulgaria and Czechia. In what follows, deeper insights were provided into the wavelet coherence approach. The results for Bulgaria are illustrated in Figure 1.

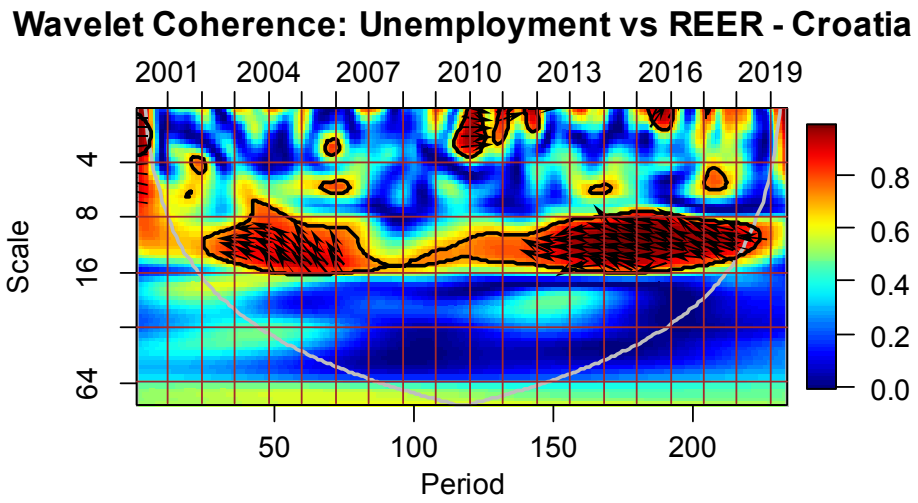
Figure 1 The case of Bulgaria



Source: Author's estimates

The time period under consideration is displayed on the horizontal axis. The vertical axis shows the scale - the lower the scale, the higher the frequency. Regions in the time-frequency domain, where the unemployment and real effective exchange rate series co-move, were identified by wavelet coherence. As can be seen on the right-hand side of the figure, regions colored dark red denote a high degree of correlation, whereas the area colored blue denotes a lower degree of correlation between the observed series. The areas outside of the bounded regions were not significant at the 5% level. An arrow in the figure represents the leading or the lagging phase in correlation between the series under consideration. Furthermore, larger scales and lower scales represent long-term and short-term co-movement, respectively. As can be seen in Figure 1, there was a prominent correlation on a larger scale from the beginning of the observation period up to year 2010. The arrows pointing to the left (a negative correlation) and up (unemployment as a leading variable) indicate that the unemployment rates and the real effective exchange rates in Bulgaria were in anti-phase, while the unemployment rate was the leading variable. Therefore, for the first ten years of the observed data sample in Bulgaria there was a decrease in the unemployment rate (Figure 2) that was followed by depreciation of the real effective exchange rate (Figure A2). Afterwards, a significant and prominent correlation was indicated in the middle of scale (between 8 and 16) and a positive correlation with the real effective exchange rate as a leading series. Therefore, after the 2008 crisis, real depreciation of the exchange rate was followed by an increase in unemployment in Bulgaria. Following the same approach, the results obtained for Croatia were illustrated in Figure 2.

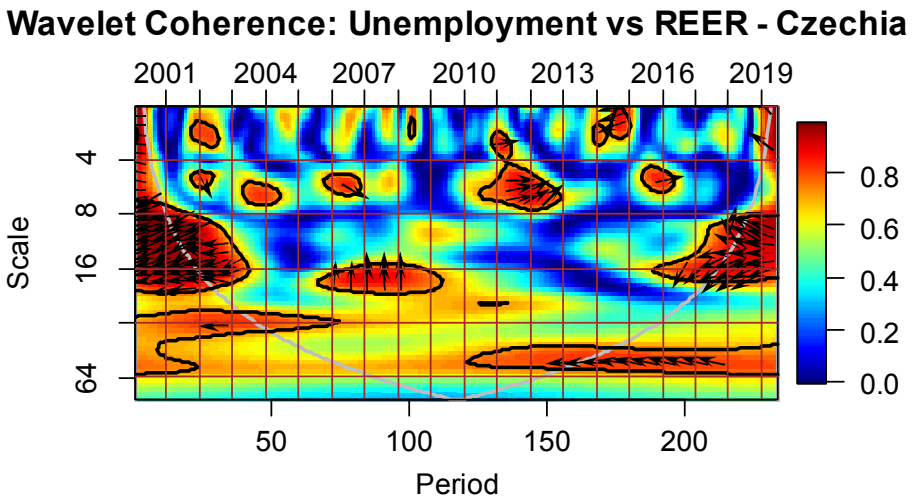
Figure 2 The case of Croatia



Source: Author's estimates

As indicated in Figure 2, in the case of Croatia, a significant and high correlation was identified in the middle of scale (between 8 and 16). However, the correlation was less prominent during the 2008 crisis period. The correlation was negative and the unemployment rate was the leading variable during the periods of significant correlation. Therefore, a decrease in unemployment was followed by depreciation until the 2008 crisis. After that, there was an increase in the unemployment rate that was followed by real appreciation of the exchange rate. The results for Czechia are illustrated in Figure 3.

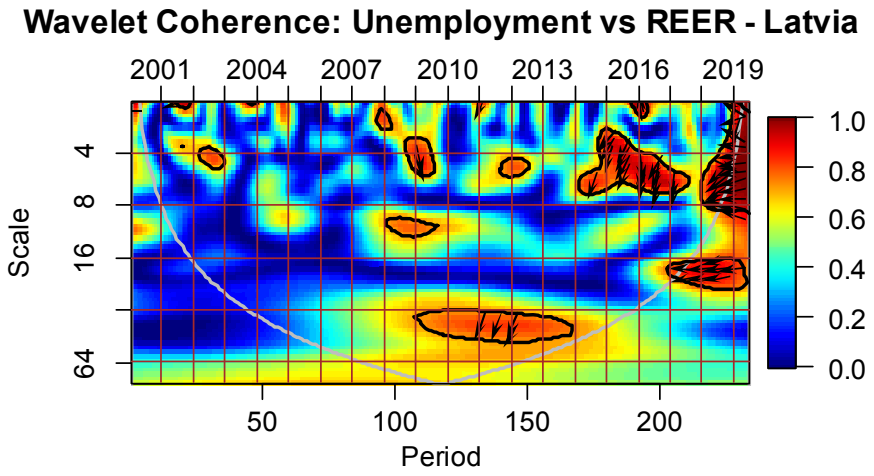
Figure 3 The case of Czechia



Source: Author's estimates

By looking at the results in Figure 3, one can observe a pattern similar to the case of Croatia by the 2004. There was no significant correlation in the period from 2009 to 2010. After 2010, there was a negative correlation but with the two of the observed variables interchanging their leading positions. The unemployment rate was a leading variable at a lower frequency domain and there was depreciation in its real terms while unemployment was decreasing. The results for Latvia are illustrated in Figure 4.

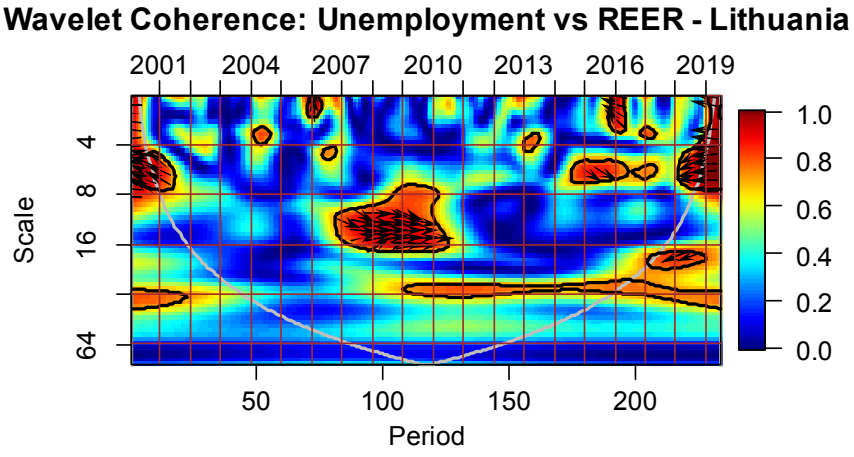
Figure 4 The case of Latvia



Source: Author's estimates

As illustrated in Figure 4, no significant correlation was found in the case of Latvia by the year 2009. After that, the correlation was negative with the real effective exchange rate as the leading variable. Therefore, real depreciation of the exchange rate was followed by a decrease in the unemployment rate. Latvia has been a member of the EMU since 2014, which corresponds to more prominent co-movements that can be seen in Figure 4. Figure 5 illustrates the case of Lithuania.

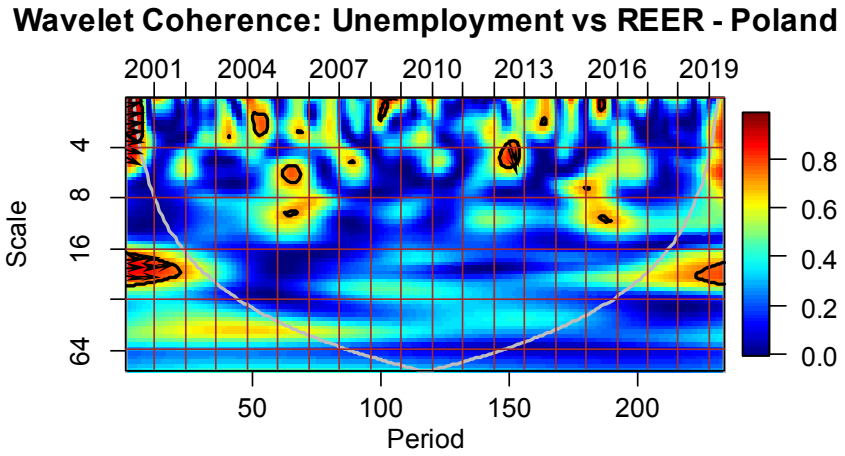
Figure 5 The case of Lithuania



Source: Author's estimates

As can be seen in Figure 5, at the beginning of the observation period there was a significant and negative correlation with unemployment as the leading variable. A decrease in unemployment was followed by real depreciation of the exchange rate. From 2007 to 2011, the correlation coefficient turned to its positive values and the real effective exchange rate and unemployment developed simultaneously. After that, there was a mixture of relationships in the case of Lithuania. Lithuania has been a member of the EMU since 2015 and no difference in co-movements can be detected as a result of EMU membership. The results for Poland are illustrated in Figure 6.

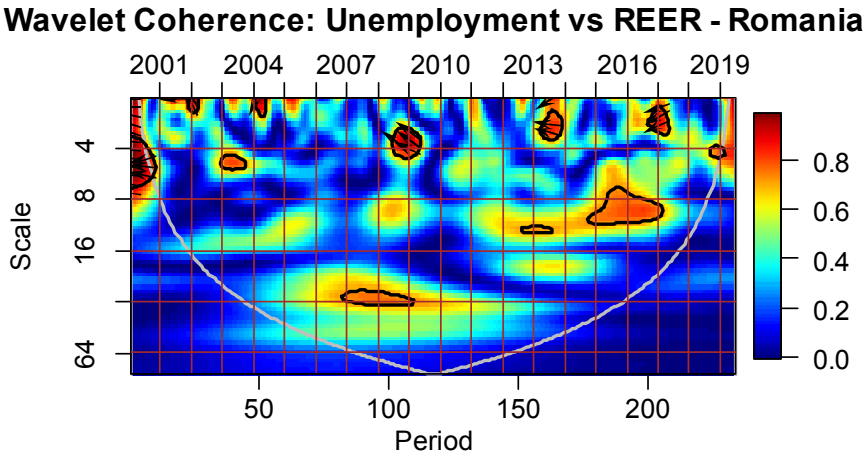
Figure 6 The case of Poland



Source: Author's estimates

As illustrated in Figure 6, in the case of Poland, there was prominent, significant and simultaneous development between the two of the observed series in the first two years of the observation sample. After that, no significant correlations were detected. The results for Romania are presented in Figure 7.

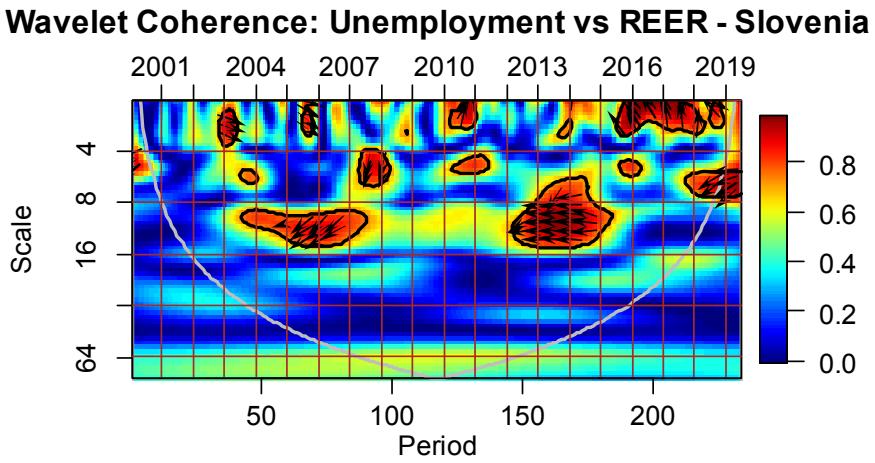
Figure 7 The case of Romania



Source: Author's estimates

As illustrated in Figure 7, in the case of Romania, there are periods of significant correlations and the sign was negative with unemployment as a leading variable. However, the periods of significant correlation did not last for more than two years continuously. The results for Slovenia are illustrated in Figure 8.

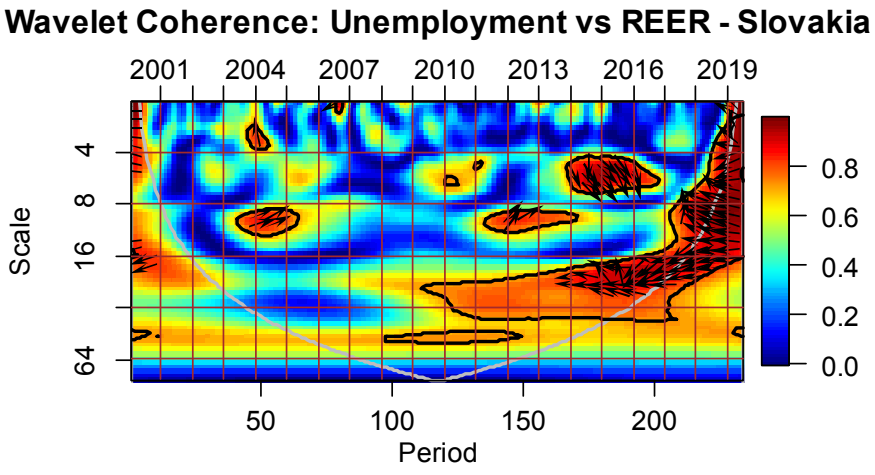
Figure 8 The case of Slovenia



Source: Author's estimates

It can be seen in Figure 8 that there were periods of significant and high correlations. Prior to 2004, the correlations were positive with real exchange rate depreciation as the leading variable. After 2004, the correlation was negative and on a larger scale one can see synchronized anti-phase movements or the real effective exchange rate as the leading variable. Slovenia has been a member of the EMU since 2007 and results in Figure 8 illustrate a theoretically consistent relationship during the EMU membership period. Figure 9 illustrates the case of Slovakia.

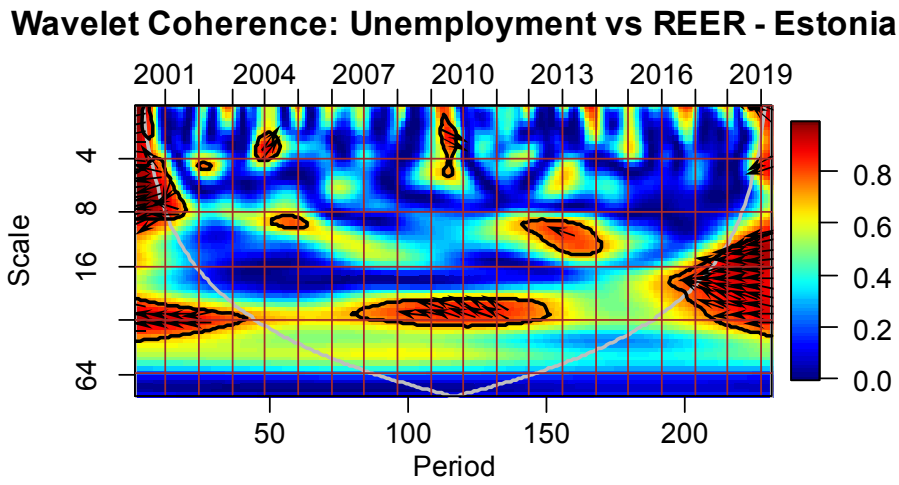
Figure 9 The case of Slovakia



Source: Author's estimates

Figure 9 illustrates a significant and prominent correlation around the year 2004. At that time, a correlation was positive and the unemployment rate was the leading variable. After the 2008 crisis, the correlations turned to be negative. The unemployment rate and the real effective exchange rate were in anti-phase, while the co-movements were synchronized or the unemployment rate was the leading variable. Slovakia has been a member of the EMU since 2009, which corresponds to a more prominent and significant relationship between the real effective exchange rate and unemployment. Figure 10 illustrates the case of Estonia.

Figure 10 The case of Estonia



Source: Author's estimates

Figure 10 illustrates a significant correlation of high magnitude during the whole observation period, though at different scales. The unemployment rate and the real effective exchange rate were in anti-phase all the time. The unemployment rate was a leading variable or the co-movements were synchronized. Estonia has been a member of the EMU since 2011 and no specific change in co-movements was identified since EMU membership. Faďoš and Bohdalová (2019) examined unemployment gender inequality and found country-specific relations between the unemployment rates and unemployment gender inequality. The research furthermore suggests that the observed panel data structure hysteretic nature of unemployment for 27 European Union countries was rejected, indicating no long memory in unemployment for the considered sample countries. In the first part of the observation period a decrease in the unemployment rate was followed by depreciation of the real effective exchange rate in the case of Bulgaria, Croatia, Czechia and Lithuania. These findings might potentially suggest pro-cyclical monetary policy. After the 2008 crisis, real depreciation of the exchange rate was followed by an increase in unemployment in Bulgaria, while in Croatia there was an increase in the unemployment rate followed by real appreciation of the exchange rate. Real depreciation of the exchange rate was followed by a decrease in the unemployment rate in Latvia. The cases of Croatia and Latvia were in line with the theoretical assumption, while the case of Bulgaria can be explained with bargaining power documented as recognized by Vasilev (2020). In the cases of Estonia, Slovakia and Romania, empirical results were in line with baseline theory. In the case of Poland, no clear conclusion can be drawn from the obtained results. In Slovenia, depreciation of the real effective exchange rate was followed by an increase in the unemployment rate prior to 2004 when Slovenia joined the EMU. Following Galindo et al. (2007), depreciation of the real effective exchange rate might increase unemployment rates in highly dollarized economies. The relationship between the real effective exchange rate and the unemployment rate in Slovenia was in line with the theory.

5. Conclusion

Research results presented in this paper point out several conclusions. Firstly, research results obtained by a conventional approach suggest no significant correlation between the real effective exchange rate and unemployment in the cases of Poland and Lithuania. In the cases of Latvia and Slovenia, the standard correlation coefficient was positive and therefore not theoretically consistent. In other six considered countries correlation coefficients were negative, which supported the theoretical assumption. Wavelet coherence analysis employed in this paper revealed a variety of co-movements depending on a specific country, point in time and frequency considered. Generally, co-movements were more prominent on a larger scale or a lower frequency, pointing out possible alignments of the real effective exchange rate and unemployment to the relationship assumed by the theory in the long run. Furthermore, the relationship was broken during the 2008 crisis period. Eventually, the assumed relationship between the real effective exchange rate and unemployment holds for most of the membership period in all of the EMU members considered. In the first part of the observation period, a decrease in the unemployment rate was accompanied by depreciation of the real effective exchange rate in the cases of Bulgaria, Croatia, Czechia and Lithuania, suggesting pro-cyclical monetary policy. Prior to joining the EMU, in Slovenia, depreciation of the real effective exchange rate was accompanied by an increase in unemployment. During the crisis that started in 2008 no statistically significant relationship between the real effective exchange rates was found. After the crisis, this relationship was mostly found to be in line with the theoretical assumption, with the exception of Bulgaria, where depreciation of the real effective exchange rate corresponded to an increase in unemployment rates, and Poland, where a significant correlation between variables under consideration was not found. The research presented in this paper illustrated a comprehensive overview of the relationship between the real effective exchange rate and unemployment in post-transition Europe. Generally, based on empirical findings from this paper, depreciation of real effective exchange rates might be used as a policy instrument to boost employment within sample countries under study. At the same time, our results call for further research to reveal the mechanism of interaction through country-specific research and including other variables that may play a role, like trade openness and economic growth of a country or any other specifics of a country that may affect the relationship.

References

1. Andor, L. (2016). Towards shared unemployment insurance in the euro area. *IZA Journal of European Labor Studies, 5*(1), 1-15. https://doi.org/10.1186/s40174-016-0060-7
2. Benazić, M. & Rami, J. (2016). Monetary policy and unemployment in Croatia. *Ekonomska istraživanja, 29*(1), 1038-1049. https://doi.org/10.1080/1331677X.2016.1211955
3. Bošnjak, M. (2018). Financial eurization in Croatia and its (non)linear pattern behaviour. *Croatian Operational Research Review, 9*(1), 51-62. https://doi.org/10.17535/crorr.2018.0005
4. Campolmi, A. & Faia, E. (2015). Rethinking optimal exchange rate regimes with frictional labor markets. *Macroeconomic Dynamics, 19*(5), 1116-1147. https://doi.org/10.1017/S1365100513000758
5. D'Adamo, G. & Rovelli, R. (2015). Labour Market Institutions and Inflation Differentials in the EU. *IZA Discussion Paper No. 9389.* IZA – Institute of Labor Economics, Bonn.
6. Demir, E., Bilgin, M. H., Karabulut, G. & Doker, A. C. (2020). The relationship between cryptocurrencies and COVID-19 pandemic. *Eurasian Economic Review, 10*(3), 349-360. https://doi.org/10.1007/s40822-020-00154-1
7. Devereux, M. B. & Yu, C. (2017). Exchange rate adjustment in financial crises. *IMF Economic Review, 65*(3), 528-562. https://doi.org/10.1057/s41308-017-0033-5
8. Faďoš, M. & Bohdalová, M. (2019). Unemployment gender inequality: Evidence from the 27 European Union countries. *Eurasian Economic Review, 9*(3), 349-371. https://doi.org/10.1007/s40822-018-0107-3
9. Galindo, A., Izquierdo, A. & Montero, J. M. (2007). Real exchange rates, dollarization and industrial employment in Latin America. *Emerging Markets Review, 8*(4), 284-298. https://doi.org/10.1016/j.ememar.2006.11.002
10. Geerolf, F. (2019). *The Phillips Curve: a Relation between Real Exchange Rate Growth and Unemployment.* https://fgeerolf.com/phillips.pdf
11. Horváth, B. & Magda, R. (2018). The relations of unemployment rate and inflation in the European Union. *Management, 32*(1), 9-20.
12. Huang, C. H. & Yang, C. Y. (2015). European exchange rate regimes and purchasing power parity: An empirical study on eleven eurozone countries. *International Review of Economics & Finance, 35*, 100-109. https://doi.org/10.1016/j.iref.2014.09.008
13. Jiang, C., Jian, N., Liu, T. Y. & Su, C. W. (2016). Purchasing power parity and real exchange rate in Central Eastern European countries. *International Review of Economics & Finance, 44*, 349-358. https://doi.org/10.1016/j.iref.2016.02.006
14. Junicke, M. (2017). Trend inflation and monetary policy in Eastern Europe. *Macroeconomic Dynamics, 23*(4), 1649-1663. https://doi.org/10.1017/S1365100517000372
15. Karabulut, G., Bilgin, M. H. & Doker, A. C. (2020). The relationship between commodity prices and world trade uncertainty. *Economic Analysis and Policy, 10*, 276-281. https://doi.org/10.1016/j.eap.2020.05.001
16. Karabulut, G., Bilgin, M. H., Demir, E. & Doker, A. C. (2020a). How pandemics affect tourism: International evidence. *Annals of Tourism Research, 84*. https://doi.org/10.1016/j.annals.2020.102991
17. Mosteanu, N. R. (2017). Currency pegged to a foreign currency - GCC and Europe models. *The Business and Management Review, 9*(1), 52-62.
18. Nucera, F. (2017). Unemployment fluctuations and the predictability of currency returns. *Journal of Banking & Finance, 84*, 88-106. https://doi.org/10.1016/j.jbankfin.2017.07.007
19. Pentecost, E. J. & Zarzosa Valdivia, F. (2016). Structural real exchange rate and unemployment interdependencies in Argentina. *Revista De Economía Y Estadística, 52*(1), 57-86.

20. Rathinasamy, M., Agarwal, A., Parmar, V., Khosa, R. & Bairwa, A. (2017). Partial wavelet coherence analysis for understanding the standalone relationship between Indian Precipitation and Teleconnection patterns. *arXiv preprint arXiv:1702.06568*.

21. Rua, A. (2012). *Wavelets in economics.* Banco de Portugal. https://www.bportugal.pt/sites/default/files/anexos/papers/ab201208_e.pdf

22. Saadaoui, J. (2018). Internal Devaluations and Equilibrium Exchange Rates: new evidences and perspectives for the EMU. *Applied Economics, 50*(59), 6364-6381. https://doi.org/10.1080/00036846.2018.1486019

23. Schmitt-Grohé, S. & Uribe, M. (2016). Downward nominal wage rigidity, currency pegs, and involuntary unemployment. *Journal of Political Economy, 124*(5), 1466-1514. https://doi.org/10.1086/688175

24. Slavov, S. T. (2017). Exchange Rate Regimes in Central, Eastern and Southeastern Europe; A Euro Bloc and a Dollar Bloc?. *IMF Working Paper No. 17/83.* International Monetary Fund, Washington, D.C. https://doi.org/10.5089/9781475590951.001

25. Stoupos, N. & Kiohos, A. (2017). Post-communist countries of the EU and the euro: Dynamic linkages between exchange rate. *Acta Oeconomica, 67*(4), 511-538. https://doi.org/10.1556/032.2017.67.4.2

26. Usman, O. & Elsalih, O. M. (2018). Testing the effects of real exchange rate pass-through to unemployment in Brazil. *Economies, 6*(3), 1-13. https://doi.org/10.3390/economies6030049

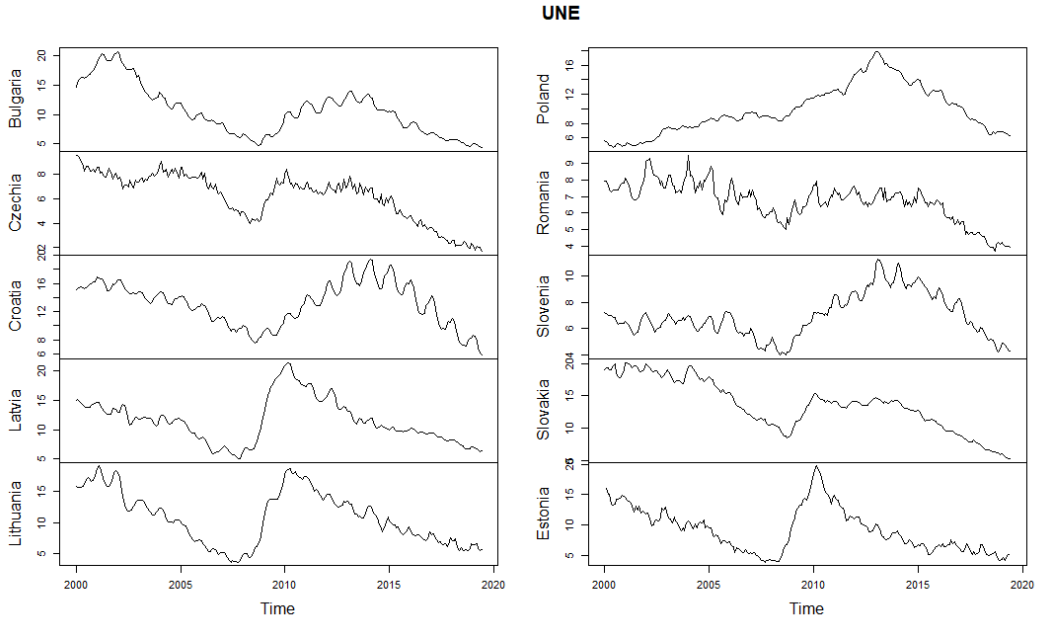
27. Vacha, L. & Barunik, J. (2012). Co-movement of energy commodities revisited: Evidence from wavelet coherence analysis. *Energy Economics, 34*(1), 241-247. https://doi.org/10.1016/j.eneco.2011.10.007

28. Vasilev, A. (2019). Are labor unions important for business cycle fluctuations? Lessons from Bulgaria. *Eurasian Economic Review, 10,* 143-161. https://doi.org/10.1007/s40822-019-00139-9

29. Xu, Y. (2019). The anchoring of inflation expectations in time and frequency domains. *Ekonomska istraživanja, 32*(1), 2044-2062. https://doi.org/10.1080/1331677X.2019.1640626

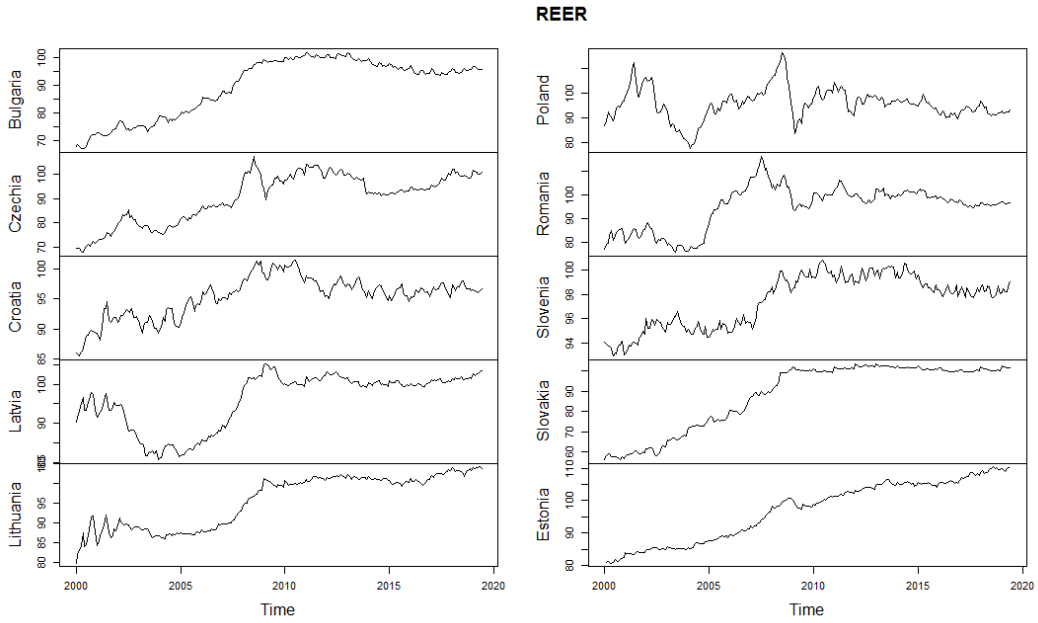
Appendix

Figure A1 Unemployment rate trends



Source: Eurostat, adapted by the author

Figure A2 Real effective exchange rate (2010=100) – an increase represents depreciation



Source: Eurostat, adapted by the author