Business Cycles in South-East Europe 1870 – 2000: A Bayesian Dynamic Factor Model

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August, 2011

Prepared for

9th Bi-annual Meeting of the European Historical Economics Society,
held in Dublin, 2nd – 3rd September 2011

71st Annual Meeting of the Economic History Association,
held in Boston/MA, 9th – 11th September 2011

Abstract

Based on a freshly built data set and relying on a Dynamic Factor Model, this paper constructs business cycle indices for five South-East European (SEE) countries (Austria-(Hungary), Bulgaria, Greece, Romania, Serbia/Yugoslavia) to address two questions: to what extent has there been a common SEE business cycle, and has there been synchronisation of business cycles with England, France and Germany? We find considerable and increasing business cycle integration before World War I (both within SEE and vis-à-vis the core economies) but as part of a pan-European business cycle (rather than specific to SEE). A regional SEE business cycle (excluding Greece) emerges only in the interwar period, based on strong trade as well as similar and (almost) simultaneous monetary events. The Great Depression does not undermine the common cycle but sees a convergence with the German business cycle. The onset of the Cold War almost completely extinguishes regional business cycle integration, but the increased economic links of some communist countries with the West (early on by Yugoslavia, from the mid-1970s also by Romania) also sees the re-emergence of a common business cycle vis-à-vis Austria and West Germany.

Keywords: South-East European business cycle, national historical accounts, common dynamic factor analysis

JEL classification: N13, N14, C43, E32

Earlier versions of this paper were presented at the EHS, IEHA and WEAI meetings and to the 5th Conference of the South-East European Monetary History Network. We are grateful to the participants for their spirited discussion and helpful suggestions. We owe a special thanks to the following people in helping us collect the data and/or sharing their data with us: Olga Christodoulaki, Giovanni Federico, Georgios Kostelenos, Georgios Mitrofanis, Max-Stephan Schulze, Coskun Tuncer, Jeff Williamson, all members of the data collection task force of the South-East European Monetary History Network (SEEMHN), and in particular Alina Blejan, Ljiljana Durdevic, Dragana Gnjatovic, Sofia Lazaretou and Thomas Scheiber. We are grateful to Mario Jovanovic, Rainer Metz and Martin Uebele for discussion on the econometrics of this paper. The usual disclaimer applies. Financial support from the British Academy is gratefully acknowledged.

1. Introduction

Despite recent contributions for Austria-Hungary (Schulze 2000, Schulze 2008) and Bulgaria (Ivanov&Tooze 2007), our knowledge of pre-WW II GDP for the SEE countries remains poor (cf. the frank assessment in Good&Ma 1999 and Maddison 2003). The situation does not improve substantially for the post-WW II data as a result of the institutional incentive of the Soviet bloc economies – in our case Bulgaria, Romania and Yugoslavia – to over-report. Conceptual differences between the System of National Accounts (SNA) as developed by the United Nations and the Material Product Accounting (MPA), its East bloc counterpart, further complicate the situation.

But even if we had "perfect" GDP data available, reconstructing the business cycle should never be confined to analysing GDP data alone. State-of-the-art studies with current data (by Stock&Watson, for instance) will rely on some 50 to 200 time series to establish the actual business cycle. The econometric methodology employed in this context is normally referred to as Common Dynamic Factor Analysis (henceforth CDFA), with some authors omitting the word "common" in the beginning.[1] Its basic idea is that a cross-section of economic variables – ranging from sectoral output over fiscal and financial variables to trade data – share a common factor. Extracting the common factor, in turn, delivers a business cycle index. CDFA can be thought of as a time-series extension of Principal Component Analysis and has been shown to be potentially superior to a business cycle reconstruction based exclusively on GDP (Ritschl et al. 2008).

While CDFA is often portrayed as iconoclastic, in reality it has a great deal in common with early work on business cycles pioneered by the NBER and epitomised by Burns&Mitchell (1946). This strand of research – much of which is forgotten today – relied on a multitude of (theoretically often not well-defined) time series which were condensed into a (country-specific) "reference cycle". Given the computational limitations at the time, such an approach was very cumbersome and involved more discretion on behalf of the researcher than was deemed appropriate; it was effectively abandoned, when modern (post-WW II) macroeconomics began

[1] As we will explain in section 3, the "factor" itself is the common element, which is why adding "common" is redundant. As most authors include the word, we decided to follow this practice.

building models centered around a small number of well-defined national accounting variables such as Y, I, G etc.[2] As a result of these very fundamental changes in the discipline of economics, business cycle research became increasingly focused on GDP as the most important (or even the only) business cycle indicator. As computational restrictions gradually eased, interest in calculating business cycles à la Burns&Mitchell (1946), i.e. by drawing on a large number of time series, resurfaced and led Geweke (1977), among others, to pioneer CDFA.

In this paper, we will follow the CDFA approach. We reconstruct the business cycles of five South-East European countries (henceforth SEE) which combined have consistently accounted for more than 85 percent of SEE GDP from the 1870s to the present: Austria(-Hungary), Bulgaria, Greece, Romania and Serbia/Yugoslavia. We will then address two questions: to what extent has there been a common SEE business cycle, and has there been synchronisation of business cycles with England, France and Germany? In so doing, this paper is a contribution to a growing body of research (Aiolfi et al. 2011; Uebele 2011) that has emphasized degrees of business cycle synchronization substantially elevated than what research reliant on GDP alone has found (Bordo&Helbling 2011, Artis et al. 2011).

But our research goes much further in addressing several issues that have featured prominently in business cycle research: first, are there regional business cycles and, if so, when have they started? The year 2011 alone has witnessed three publications tackling (among other issues) the issue of regional business cycles, with two of them highly sceptical towards such a concept before WW II (Bordo&Helbling 2011; Artis et al. 2011) and one affirmative (Aiolfi et al. 2011). None of the European regions is better suited for such a study than SEE: we have continuous data for five neighbouring countries since the 1870s/early 1880s, which compares favourably with potential competitors such as Scandinavia (3 countries[3]) or Iberia (2 countries), let alone Central and Eastern Europe where statehood of most present-day countries only materialised after WW I.

Second, how volatile and how persistent have business cycles been across countries and over time? Romer (1986, 1989) revealed the established wisdom of high

[2] It is not entirely clear how causality runs: one of the reasons why modern macroeconomics was embraced so readily in the 1950s was arguably because it reduced computing needs by agreeing on a small number of variables. We thank Paul David for drawing our attention to what the fundamental changes in economics at the time meant for the sub-field of business cycle studies.

[3] Potentially four countries, if we include Finland which was an autonomous duchy within Tsarist Russia from 1809 to 1917.

pre-WW I volatility as a figment of the data for the case of the US, but subsequent research has found it difficult to generalize her findings for other countries. The only thing most scholars can agree on is that the interwar period stands out as particularly volatile (Basu&Taylor 1999). As for volatility across countries, the lack of detailed studies on this in historical perspective is surprising (Aiolfi et al. 2011 being an exception) given that research on current data has a strong focus on this topic.

Last but not least, this paper not only aims at documenting but also at explaining business cycles over time: have global shocks become more important over time relative to regional and/or country specific shocks, leading to higher synchronization in the process? Recent contributions have found it easier to agree on the right methodology to address these issues, but the empirical findings are often diametrically opposed to each other (Bordo&Hebling 2011, Artis et al. 2011, Aiolfi et al. 2011).

At the current stage of our research, we are in a position to establish the business cycles and to analyse business cycles across countries and over time, thereby addressing the issue of if and when regional business cycles have emerged. We found it worthwhile to spell out the other two questions, partly because they will guide us in interpreting some of our results below. Later research is meant to turn some of our observations into testifiable hypotheses along the lines suggested by Bordo&Hebling (2011), Artis et al. (2011) and Aiolfi et al. (2011).

We will proceed as follows: In the second section, we will explain why a business cycle reconstruction based on national historical accounts is not necessarily superior to the proposed CDFA and why it might even be worse. Our concerns partly stem from the idiosyncrasies of SEE GDP data, partly from general considerations as to why national historical accounts are unlikely to reflect the true but unknown GDP series. In the third section, we will explain the CDFA methodology and outline the time series we are using for constructing business cycle indices. We will also show how well the chosen methodology works by comparing business cycles based on CDFA with business cycles based on historical national accounts for a sub-set of countries for which we have reliable and reputable historical GDP data. In the fourth section we will then address the two main questions of this paper, i.e. to what extent has there been a common SEE business cycle, and has there been synchronisation of business cycles with England, France and Germany? The fifth section summarises and concludes.

2. Pitfalls of a business cycle reconstruction based on historical national accounts

In a perfect world, we would study business cycles by analysing GDP data on annual frequency (or even higher frequency). In this section, we will explain why historical national accounts are not as helpful for this purpose as they initially appear. Our concerns partly stem from the idiosyncrasies of SEE GDP data, partly from general considerations as to why historical national accounts are unlikely to reflect the true but unknown GDP series.

The most obvious limitation of SEE GDP data refers to the period 1870 – 1918. GDP estimates on an annual basis are available only for Austria-Hungary (Schulze 2000), Bulgaria (Ivanov 2009) and Greece (Kostelenos et al. 2007), of which only the data for the dual monarchy has made it into the Maddison (2003) data set. By contrast, the Kostelenos data have not been universally accepted and the annual estimates of Ivanov have not yet been published in English (Ivanov&Tooze 2007 and Ivanov 2006 is confined to the benchmark years of 1892, 1899, 1905, 1911, 1921 and 1924). The pre-WW I SEE GDP data reported by Maddison (2003) are on a decadal basis only (except for Austria-Hungary); moreover, the data do not constitute genuine GDP data but the results of proxy estimates by Good&Ma (1999), who draw on (a) the share of non-agricultural employment in the labour force, (b) the crude birth rate, and (c) letters posted per capita to approximate overall economic activity.[4]

For the interwar period, Maddison (2003) reports GDP data for all five SEE countries. If the detailed critique of the Maddison data for Bulgaria by Ivanov&Tooze (2007) has implications for other countries (as is likely), then we have good reason to be equally sceptical towards the interwar data reported for Greece, Romania and Yugoslavia.

The post-WW II data are beset with yet another problem: the institutional incentive of the East bloc economies – in our case Bulgaria, Romania and Yugoslavia – to over-report. Conceptual differences between the System of National Accounts (SNA) developed by the United Nations and its East bloc counterpart, the Material Product Accounting (MPA), further complicate the situation.[5]

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[4] The Greek case is somewhat different; for details cf. Morys (2006).

[5] It is not easy to compare SNA and MPA in any straightforward sense, but MPA can be thought of as GDP excluding the service sector.

But even if we leave the idiosyncrasies of SEE GDP data aside for the moment, an argument can be made for relying on CDFA rather than historical national accounts. These considerations have led to the use of CDFA even for countries such as the US (Ritschl et al. 2008) and Germany (Sarferaz&Uebele 2009) for which much more reliable GDP are available. First, national historical accounts are normally constructed with an eye for the level rather than the volatility; this (understandable) preference determines interpolation techniques which can lead to serious differences in volatility between the reconstruction and the true but unknown GDP series. Second, disaggregate series are often abundant for historical periods, but in many cases do not match national accounting categories very well; CDFA allows us to exploit the business cycle characteristics of these series. Third, CDFA deals better with structural breaks in sub-series than GDP, as CDFA is more flexible in excluding disaggregate time series with serious faults.[6]

All three issues raised are likely to be of more concern the further we go back in time. Table 1 provides an overview of business cycle synchronization before WW I according to previous research, differentiating between (1) intra-core, (2) intra-periphery and (3) core-vis-à-vis-periphery. In the case of the latter two categories, we report synchronization for peripheral countries *emanating from the same region* provided such information could be extracted from the publication (as we might expect synchronization to be high between, for instance, Sweden and Denmark but not necessarily between Sweden and Japan). As Scandinavian countries are overrepresented in the studies (as a result of better GDP), we report results for Sweden, Denmark, Norway and (occasionally) Finland to provide an idea of synchronization levels for a peripheral region before WW I.

[Insert Table 1 about here]

The column to the right in table 1 gives the statistical method and the underlying data. As for the statistical method, we see that most of the research relies on GDP. The only exceptions are an early study by Morgenstern (1959) following the NBER methodology and a recent paper by Uebele (2011).

[6] For a more detailed comparison of both techniques cf. Ritschl et al. (2008) and Aiolfi et al. (2006).

Focusing on the GDP-reliant studies only for the moment, we find that none of the average correlations reported exceeds 30% and many of them are below 10%; particularly astonishing are the low results for intra-core correlations none of which surpasses 10%.

These results are probably in contradiction with our expectations: the period 1870 – 1914 is often referred to as the First Age of Globalization the key characteristics of which – highly integrated factor and product markets as well as a quasi-universal system of fixed exchange-rates in the form of the gold standard (Daudin&Morys&O'Rourke 2008) – should all be conducive to a high level of business cycle synchronization. This mismatch between studies on business cycles for the 1870 – 1914 period and what we expect the synchronization to be has become known as the business cycle paradox (Bordo&Helbling 2011; Artis et al. 2011).

This paradox can be overcome in two different ways: either the correlation between business cycle synchronization and market integration is not necessarily positive. Krugman (1993), for instance, noted that stronger trade integration may lead to greater regional specialisation, which can lead to less output synchronization due to industry-specific shocks. Alternatively, the underlying data – i.e. GDP – poses the problem. Table 1 also includes Morgenstern's (1959) work which follows the NBER tradition in not relying on GDP but, instead, on reference cycles established by drawing on a multitude of time series. Using NBER reference cycles, Morgenstern showed that the UK, France and Germany were in phase in fully 83 per cent between 1870 and 1914. He also found the US cycle to be in phase with the European cycle in 54 per cent of months. In earlier work, the idea of a closely integrated pan-European business cycle had already found statistical support by Mitchell (1927), and Kuznets (1958) came to a similar result for a sample of Atlantic economies.

In sum, the earlier work by Mitchell (1927), Kuznets (1958) and Morgenstern (1959) is indirectly supportive of our concerns over using GDP data for the purpose of business cycle studies. The question then is if we adopt a methodology to overcome these concerns – and which is, as will become clear, much more in line with earlier work following the NBER tradition –, does such an approach also lead to compelling evidence for a pan-European and even global business cycle before WW I? This is what we turn to now.

3. Explaining and applying common dynamic factor analysis

The model

The Common Dynamic Factor Model is best understood behind the background of its parent model, the static factor model, which takes the following form:

$$\underset{(n \times 1)}{y_t} = \underset{(n \times 1)}{\lambda_0} + \underset{(n \times o)\,(o \times 1)}{\lambda\, f_t} + \underset{(n \times 1)}{\varepsilon_t} \quad (1)$$

y_t is a (n x 1) vector of variables y_{it} with = 1 to n (with n = 25 in our case) and t = 1870 to 2000. Factor models posit that the different y_i's (i.e., the different time series) are explained partly by a common component and partly by a variable-specific (or idiosyncratic) component. This dual structure is captured in the second and the third summand (the first summand simply being a vector of variable-specific intercepts). f_t is a (o x 1) vector of unobserved latent factors (where $o << n$) which are common to every y_i though different factors might be of different importance for different y_i's (as factor loadings – i.e., the entries in the (n x o) matrix λ – may differ in different rows). The third summand – i.e., the different ε_i's – capture the idiosyncratic component.

Static factor models are turned into dynamic factor models by allowing for dynamic properties typical of macroeconomic variables. As we are dealing with a common and an idiosyncratic component, the necessary extensions relate to the second and the third summand of (1) which we re-write below for individual y_i's.

$$\underset{(1 \times 1)}{y_{it}} = \underset{(1 \times 1)}{\lambda_{0i}} + \underset{(1 \times o)\,(o \times 1)}{\lambda_i\, f_t} + \underset{(1 \times 1)}{\varepsilon_{it}} \quad (2)$$

Different dynamic properties can be assumed but there is little reason to deviate from standard assumptions according to which f_t follows a VAR(p) process while ε_{it} follows a AR(q) process. To emphasize the different nature of the autoregressive process (vector versus scalar), we choose Φ (o x o) and φ (scalar), respectively.

$$(3)\quad \underset{(o \times 1)}{f_t} = \underset{(o \times o)}{\Phi_1}\ \underset{(o \times 1)}{f_{t-1}} + \underset{(o \times o)}{\Phi_2}\ \underset{(o \times 1)}{f_{t-2}} + \ldots + \underset{(o \times o)}{\Phi_p}\ \underset{(o \times 1)}{f_{t-p}} + \underset{(o \times 1)}{\zeta_t}$$

$$(4)\quad \varepsilon_{it} = \varphi_{i1}\,\varepsilon_{i,t-1} + \varphi_{i2}\,\varepsilon_{i,t-2} + \ldots + \varphi_{iq}\,\varepsilon_{i,t-q} + \eta_{it}$$

(all variables are scalars)

The model requires several identifying assumptions, the most important of which is that we assume ζ_t to be i.i.d. N(O, I_n). For more details cf. Koop&Korobilis (2010: 52-53).

We interpret the first factor (i.e., the first element of the (o x 1) vector f_t) as the business cycle for the specific country under investigation; “first factors” in CDFA is the equivalent to the first principal component in principal component analysis, i.e., it explains more of the covariance structure than the second factor, which, in turn, explains more than the third etc. CDFA studies differ as to whether they extract only one factor (Sarferaz&Uebele 2009) or more than one factor (Aiolfi et al. 2011). Extracting more than one factor offers the possibility to interpret, for example, one of the factors as capturing cyclical movements in the real economic sphere while another one might relate to the financial sphere; in empirical work, however, such a clear-cut distinction (of this sort or another) is difficult to establish (as conceded by Aiolfi et al. 2011: 215) which is why we confine ourselves to extracting one factor.

Estimating the model

Classical as well as Bayesian procedures are available for CDFA (Aiolfi et al. 2011 versus Sarferaz&Uebele 2009). We have opted for the Bayesian approach, as it tends to deliver superior results when dealing with time series of limited length; due to poor data reporting in both World Wars, estimation needed to be carried out separately for the pre-WW I, interwar, and post-WW II periods.

Calculations were carried out with Matlab relying on a code developed by Koop and Korobilis.[7] p and q were set at 8 and 1, respectively; different assumptions were tried out but our findings hardly changed.

Raw data series were transformed into logarithms (except for domestic interest rate, terms of trade and real effective exchange rate where levels were used) and subjected to the Hodrick-Prescott filter (with a smoothing parameter $\lambda = 6.25$). The resulting 25 cyclical series (for each country) were then standardised by adjusting the mean to naught and the standard deviation to unity; this step is crucial in ensuring that each series y_i is given equal weight in establishing the business cycle.

Robustness checks

The main concern from an econometric perspective does not relate to the exact specification of the CDFA model but to the filtering techniques used to transform the raw data into y_i. More specifically, econometricians have long argued that filters might generate cycles not present in the underlying data, potentially resulting in spurious correlations between time series subjected to the same filtering technique.[8]

To address this issue, we therefore carried out the same calculations with three different filters: Hodrick-Prescott (both with $\lambda = 6.25$ and $\lambda = 100$), Baxter-King and simple first differences (all with respect to log data), but results hardly changed. In the following, we will report results based on the HP-filter (with $\lambda = 6.25$) which probably remains the most widely used filter in macroeconomics, thereby allowing (marginally) better comparability with other studies.

[7] The code can be downloaded on Koop's webpage under "MATLAB Code for Factor Models" under http://personal.strath.ac.uk/gary.koop/bayes_matlab_code_by_koop_and_korobilis.html

[8] Cf. the comment of Metz (2009) on the paper by Uebele&Ritschl (2009).

3.2 Time series used and data sources

We suggest to include 25 time series for each country, ranging from sectoral output indicators over fiscal and financial variables to trade data (table 2). Crucially for our purpose, economic theory suggests some connection to the business cycle for all of the variables included. There is considerable variety among CDFA studies on the number and the characteristics of time series to be included (Sarferaz&Uebele 2009, Ritschl et al. 2008, Aiolfi et al. 2011); given that we want to ensure maximum comparability of results across countries and over time we decided to go for a medium size list of variables the great bulk of which could be located for all 5 SEE countries and 3 core countries for the entire period of 1870 to 2000.

[Insert Table 2 about here]

South-Eastern Europe is often seen as *terra incognita* by cliometricians but our data collection efforts show that a "new economic history" of SEE could easily be written. Based largely on Statistical Yearbooks (publication of which started shortly after independence of the SEE countries in the 19th century), we have been able to construct a minimum of at least 16 annual time series for each country for the period 1870 – 2000 (with the exception of war years; due to independence occurring later, data for Bulgaria, Romania and Serbia/Yugoslavia start in 1887, 1881, and 1886, respectively). Additional sources were used in particular for the post-WW II period, where local sources for Bulgaria, Romania and Yugoslavia were double-checked with Western sources on Soviet bloc countries (mainly by the Vienna Institute for International Economic Studies, one of the few Western institutes with reliable data on Eastern Europe for the Cold War period). For England, France and Germany we were able to rely on readily available data. Table 3 summarises the estimation periods and the number of underlying time series for each country. A full summary of the sources can be found in the appendix.

[Insert Table 3 about here]

3.3 Preliminary findings; CDFA versus historical national accounts

Before presenting our full results in the next section, we wish to bolster confidence in CDFA by addressing two issues: first, how do business cycles based on CDFA compare with business cycles based on GDP for countries for which we have good GDP data? Second, is there a certain set of time series actually driving the business cycle?

As indicated above, in the case of several SEE countries we have to rely on CDFA due to the absence of annual GDP data before WW I. For England, France, Germany and Austria-Hungary, we have reliable and reputable GDP data (as proxied by inclusion into Maddison (2003)) for this period, allowing us direct comparison between the two approaches to reconstruct business cycles (table 4).

[Insert Table 4 about here]

If – either based on our understanding of the First Age of Globalization or earlier work inspired by the NBER tradition (cf. section 2) – we expect correlation to be high, then table 4 unmistakably demonstrates the superiority of CDFA over GDP. The average correlation for England, France and Germany is 0.80 (and very similar to the value found by Morgenstern (1959), cf. table 1); including Austria-Hungary, the average value of 0.78 remains more than three time higher than the value found for GDP-based calculations (0.25). England and Germany, for instance, share a 81% correlation based on CDFA but only 2% based on GDP; a similarly striking contrast is to be found between Germany and Austria-Hungary (0.84 (CDFA) vs. 0.02 (GDP)).

Turning to the second question, correlation coefficients are helpful in comparing the business cycle index with the 25 individual time series that went into it. This procedure allows us to establish which of the individual time series really drives the national business cycle. While there are obviously differences between the 21 business cycle reconstructions we carry out (8 countries with 3 distinct estimation periods each, i.e. pre-WW I, interwar, and post-WW II; results for England, France and Germany post-WW II rely on GDP at the stage of our research), some general observations can be made: manufacturing, construction and transportation normally exhibit the highest correlation with the business cycle (often 70% and above), followed by monetary aggregates (M0, M3), exports and government revenue. In our

view (cf. also Uebele 2011 on this issue), the high level of correlation can either result from the time series being genuinely important for the business cycle – i.e., a good proxy from an economic point of view, such as manufacturing and construction – or because the time series represents very accurately reported historical data (M0 and government revenue would fall in this category). As both conditions are rarely fulfilled in applied work, there is usually a trade-off between proximity to the business cycle from a theoretical perspective and data quality. This trade-off is particularly pronounced in cases where several key time series are not accurately reported; in these situations (Greece pre-WW I, for instance), the business cycle is largely the result of a limited number of time series which were reported with great precision (M0, for instance, in the case of pre-WW I Greece). This finding vindicates the somewhat eclectic approach of CDFA which relies on a large number of time series.

4. Business Cycles in South East Europe, 1870s–1989

Our measure of business cycle synchronization

Business cycle synchronisation can be measured in different ways. The most complicated (and least frequently used) methodology involves spectral analysis; based on Fourrier transformation, a cycle A is dissected into a multitude of cycles of different periodicity and then compared to a similarly decomposed cycle B. Spectral analysis can, for example, establish that two time series are highly correlated at one periodicity but less so at another. This technique, then, is applied especially in cases (e.g., A'Hearn&Woitek 2001) in which the research tries to distinguish between cycles of different length (either suggested by economic theory or empirical work) such as the Juglar (1889) cycles (fluctuations of 7-10 years) and the Kitchin (1923) cycles (fluctuations of 3-4 years).

More widely used is the Harding&Pagan (2002) concordance index. Emanating from the NBER tradition of business cycle research, national business cycles are said to be synchronized if turning points in the corresponding reference cycles are at the same time (or at least close to each other); in other words, synchronisation means that national business cycles are in the same phase – expansion or recession – at the same time.

The most widely used indicator for business cycle synchronization is Pearson's correlation coefficient. To our knowledge, most if not all of the recent research into historical business cycles has relied on this indicator (Bordo&Helbling 2011, Artis et al. 2011, Sarferaz&Uebele 2009, Uebele 2011); which is why we will employ it in the following to allow for direct comparison with earlier work. More specifically, our measure of business cycle synchronization is the bilateral correlation of the (country-specific) business cycle index as calculated by CDFA.

4.1 Pre-WWI: 1870s - 1913

Table 5 shows business cycle synchronization among the eight countries under investigation, i.e. the SEE-5 and England, France and Germany. For each country pair we provide correlations for three different periods: the full period (which is given by pair-wise intersection of the estimation period in table 3); 1893-1913; 1903-1913. While shortening the period makes it more difficult to ascertain statistical significance, it will become clear in the following why reducing the full period is warranted. Table 6 provides summary statistics of the (8 * 7) / 2 = 28 bilateral correlations (and sub-groups thereof) of table 5

[Insert Table 5 about here]

[Insert Table 6 about here]

Tables 5 and 6 reveal an increase in business cycle synchronization the closer we move to WW I. Comparing the full period with the last decade, the median and the average increase from 0.27 to 0.56 and from 0.34 to 0.44, respectively, and the number of statistically significant correlations increases from 12 to 16 (notwithstanding the fact that shorter periods require higher correlations to establish statistical significance). The results are interesting both in terms of synchronization levels as well as changes thereof over time.

As far as levels are concerned, we show that synchronization was not negligible. Our average value of 0.34 compares "favourably" to the 0.03 and 0.02 reported in Bordo&Helbling (2011: 212) and Artis et al. (2011: 186) (both of whom rely on larger samples for the 1880-1913 period but use GDP instead).

As for the increase in synchronization, our results confirm a proposition advanced by Bordo&Helbling (2011) but add nuance to it. Bordo&Helbling (2011) find a secular trend towards increased synchronization from 1880 to the present day; while they find this increase from one period to the next (gold standard; interwar period; Bretton Woods; modern floating era)[9], our results indicate that increases also occurred within periods. If we see the correlation between market integration and business cycle synchronization as positive (cf. above), this finding should not come as a surprise; studies on market integration during the First Age of Globalization have shown markets as increasingly integrated the closer we come to the end of the period (O'Rourke&Williamson 1999, Daudin&Morys&O'Rourke 2008).

Intra-core correlations

Although our paper is primarily concerned with SEE, we begin by analyzing business cycle synchronization among the core countries to allow comparison with earlier research (table 1). For the period 1879-1913, England, France and Germany exhibit an average correlation of 0.80; France and Germany are marginally more correlated with each other than with England which supports the concept of a more closely integrated *continental* European economy often encountered in business cycle research (Artis et al. 2011[10]).

Figure 1 shows that peak and troughs were usually not further apart by more than one year (and often identical), and several turning points are reminiscent of key events such as the business cycle upswing of the late 1880s (culminating in and reversed by the Baring crisis of 1890) and the American banking crisis of 1907 (which was preceded by a long upswing).

[Insert Figure 1 about here]

[9] The only exception they find relates to the transition from the interwar to the Bretton Woods period where synchronization levels hardly change.

[10] While this is one of the main findings of Artis et al. (2011), it is worth pointing out that they can establish a specifically continental European business cycle only for the post-WW II period.

Intra-SEE-5

In providing "benchmark" values for England, France and Germany, the stage is set for SEE. A pattern of increasing business cycle synchronization is confirmed, with the average correlation rising from 0.24 (full period) to 0.26 (1893-1913) and 0.38 (1903-1913); Austria-Hungary, Greece, Serbia and Romania all increase their bilateral correlations over time, with only Bulgaria appearing to be an outlier.

Such a trend is easily detected in figures 2 and 3. Eyeballing the data for the full period (figure 2) does not suggest a high degree of business cycle integration for the early period. If we then confine the sample to the decade before WW I (figure 3), a pattern of co-movement is apparent. For the latter period we recognise upswings and downswings which are well-documented for other countries (including England, France and Germany, cf. above): (a) the long upswing in the early 1900s, a period of global boom which ended in the bust of the American banking crisis of 1907; (b) the impact of the American banking crisis on the rest of the world; (c) another upswing starting in 1909/10 which lasted until WW I.

[Insert Figure 2 about here]

[Insert Figure 3 about here]

It is worth highlighting three issues: first, turning points are well-synchronized: they either coincide (1912) or are no more apart than one year (1907 for Austria-Hungary and Greece versus 1906 for Romania; 1909 for Romania and Greece versus 1910 for Austria-Hungary); second, the impact of the American banking crisis (failure of the Knickerbocker trust in October 1907) was both instantaneous and prolonged. While we do know about the impact of the American banking crisis on some countries on the European periphery, Italy for instance (Bonelli 1971), we are providing the first quantitative evidence that the same was true for the SEE countries. Third, while the upswing of the 1910s lasted for most countries until WW I (figure 1), it was cut short in SEE in 1912 due to the Balkan Wars (1912-13).

Our results also indicate sizeable differences among the SEE-5. Austria-Hungary and Serbia – neighbouring countries at the Western edge of the Balkans – not only show the strongest correlation with each other (0.34 / 0.55 / 0.87) but are also more

strongly synchronized with the rest of the region, followed by Romania and Greece (in that order, cf. table 6).

The only outlier is Bulgaria which exhibits decreasing correlations over time (vis-à-vis Greece even negative ones). The Bulgarian results are difficult to interpret, as we are not aware of any fundamental differences between Bulgaria and the other four SEE countries. In its main features – a backward economy largely based on agriculture, reliance on foreign capital and a late transition to the gold standard -, Bulgaria appears to have a great deal in common with Serbia, Romania (its immediate neighbours), Greece (from which it is separated by a small stretch of land before the Balkan Wars of 1912/13) and even large parts (mainly in the East) of Austria-Hungary (Lampe&Jackson 1982, Palairet 1997). The result could be driven by data series of insufficient length. Incidentally, the estimation period for Bulgaria (1887-1913) starts later than for any other country (table 3), resulting in wider confidence intervals. The current limit is set by the publication of the first *Statistical Yearbook*, but we are working on extending at least some of the time series (such as exports, imports and revenue) further back in time based on other sources.

As we suspect the problem to be with the Bulgarian data, we are also calculating business cycle synchronization based on Austria-Hungary, Greece, Romania and Serbia alone (henceforth referred to as SEE-4). Switching from the SEE-5 to the SEE-4 suggests a more rapid increase of integration within SEE and in the overall sample of SEE-4 plus England, France and Germany.

Synchronization SEE vis-à-vis England, France and Germany

Our results also suggest increased integration of SEE vis-à-vis the core countries. For the SEE-4, the correlation increases from 0.37 to 0.58 (SEE-5: 0.32 / 0.28 / 0.40). Similar to the correlations intra-SEE, we see a difference between a more synchronized Austria-Hungary and Serbia – both located on the Western edge of the Balkans – and the other three countries. Austria-Hungary constitutes a special case, as it is the only SEE country better integrated towards the West than towards the (South-)East. The other countries are approximately as much integrated with each other as they are with England, France and Germany.

Combining the evidence on synchronization levels intra-SEE and SEE vis-à-vis England, France and Germany suggests that there was no regional SEE business cycle in place before World War I. We would speak of a regional business cycle, if a group

of contiguous countries enjoyed synchronization levels substantially elevated to what they exhibit vis-à-vis countries outside of this group. This, however, is not true for our case: the SEE countries are are as much synchronized among each other as vis-à-vis England, France and Germany.

Rather, the position of Austria-Hungary seems crucial: The dual monarchy's synchronization with the core countries does not change much over time, whereas its synchronization with the other four SEE countries increases over the period (but never reaches synchronization vis-à-vis the core). Increasing business cycle synchronization of Greece, Romania and Serbia (among each other as well as vis-à-vis the core countries) appears imported from the dual monarchy which had all along been well-integrated with England, France and Germany. Rather than referring to a regional SEE business cycle, it seems more accurate to see SEE increasingly participating in a pan-European business cycle emanating from the core countries.

Statistical significance

Addressing the issue of statistical significance is particularly relevant, as we are dealing with a small number of annual observations. Roughly half of the correlation coefficients reported in table 5 (39 out of 84) are statistically significant at the 10% significance level. Wilcoxon rank sum tests (table 7) show that the increase in business cycle synchronization for the full sample is statistically significant (at the 10% level), and so is the increase in synchronization intra-SEE-4 as well as of the SEE-4 vis-à-vis the core countries. The rank sum tests then support our proposition of an increase in business cycle synchronization on the decades before WW I, and the different results for SEE-4 and SEE-5 appear to vindicate our earlier suspicion of the Bulgarian data.

[Insert Table 7 about here]

4.2 Interwar period: 1919 – 1941[11]

At first glance, business cycle synchronization appears to have continued in the interwar period at levels very similar to the decade preceding WW I (tables 8 and 9). Taking all 8 countries together, we find an average bilateral correlation of 0.42 (1919-1941) versus 0.44 (1903-1913). Such a "bird-perspective" conceals, however, substantial differences (a) between core and peripheral countries and (b) between the periods before and after 1929, i.e. the onset of the Great Depression.

How would we business cycle synchronization expect to be in the interwar period? While our findings for the earlier period are in line with how we have come to see the First Age of Globalization, it is far more difficult to agree on priors for the interwar period. Two opposing tendencies are to be expected: on the one hand, if deglobalization – starting with WW I but greatly amplified during the Great Depression – meant an implosion of trade, reduced capital flows and less migration, this should result in less closely integrated national business cycles. Similarly, the currency instability of the 1920s (a poorly synchronized process of re-establishing the gold link) and the 1930s (splintering of the gold standard into a multitude of currency blocs) was almost certainly less conducive to business cycle synchronization than the period of quasi-universal currency stability preceding WW I (or at least the two decades before WW I). On the other hand, all countries were affected by the Great Depression which can be seen in our context as a global shock (of extraordinary size); this, in turn, might have led to more synchronised business cycles than before World War I.

With our expectations unclear, it is probably no surprise that scholars have not been able to agree on an interwar business chronology, let alone on a specific interpretation (Ritschl&Straumann 2008). Most recent studies find synchronization levels higher than before World War I but they also point out to major regional differences (Backhus&Kehoe 1992, Ritschl&Straumann 2008). It is worth bearing in mind that all of the studies we refer to rely on GDP; their finding of an increase in synchronization could be driven by GDP data improving over time as much as by genuinely more integrated business cycles, with little chance to distuingish between the two.

[11] For Bulgaria, Romania and Yugoslavia the estimation period stretches beyond 1939 (table 3) due to hostilities starting only in the 1940s.

Intra-core

Compared to an average correlation of 0.80 before WW I, the correlation among England, France and Germany is substantially reduced and stands at only 0.47, with 0.29 for the period before 1929 and 0.67 thereafter (tables 8, 9).

[Insert Table 8 about here]

[Insert Table 9 about here]

[Insert Table 10 about here]

Differences between correlations before and after 1929 are not only large but statistically significant (table 10), suggesting that the two periods should be treated separately. Visualizing the English and the German business cycle (England and Germany are more strongly correlated in both sub-periods with each other than they are with France) might help explain why this is the case (figure 4). Troughs (1932) and peaks (1929 and 1937) are identical after 1929 but different before. Some well-known country-specific shocks of the 1920s can easily be identified, for instance 1923 for the German case (Ruhr occupation, general strike, hyperinflation); similarly, our findings are consistent with scholars arguing that the English business cycle was driven (and depressed) in the early 1920s by its attempt to re-peg to gold at the pre-war parity (achieved in 1925), an event with no equivalent in the German case (*inter alia* Ritschl&Straumann 2008). In other words, the historical narrative for England and Germany is consistent with the idea that the business cycles were more closely aligned in the 1930s than in the 1920s.

[Insert Figure 4 about here]

Several studies have explained their finding of increased business cycle integration in the interwar period by the common experience of the 1930s (Backus&Kehoe 1992, Basu&Taylor 1999), but few have noted that the interwar period should be treated as two distinct periods. The interpretation advanced here is supported by Wilcoxon rank sum (table 10). The increase in business cycle synchronization after 1929 is statistically significant not only intra-core but also between core and periphery (0.11

vs. 0.63). Interestingly enough, the only exception to this concept of two distinct periods is the SEE-5 whose average correlation declines marginally from 0.57 to 0.53 (with the difference not being statistically significant).

Closer inspection of the SEE countries suggests a particularly strong integration between Austria, Bulgaria, Romania and Yugoslavia (cf. figures 5 and 6). As table 8 shows, all correlations between these 4 countries are statistically significant (most even at the 1%-level) but none of the bilateral correlations of Greece are (with some of them even being negative). If we confine our sample to the SEE-4[12] (excluding Greece), the average correlation even increases to 0.72 (0.79 before 1929 and 0.77 thereafter).

[Insert Figure 5 about here]

[Insert Figure 6 about here]

Given our earlier definition of a "regional business cycle", our results show that the interwar period sees the emergence of a SEE business cycle involving Austria, Bulgaria, Romania and Yugoslavia: throughout the period, intra-SEE-4 correlations are higher than correlations vis-à-vis the core countries. The only exception to this is Germany which, after 1929, shows an average correlation of 0.78 vis-à-vis the SEE-4; we will return to this below.

This raises two questions: first, what explains the emergence of a regional business cycle in the interwar period? Second, why was Greece left out? Table 11, in providing a summary of peaks and troughs for the SEE-5, shows that turning points of Austria, Bulgaria, Romania and Yugoslavia were never further apart than one year for any country-pair. Arguably, the best explanation for the high degree of simultaneity is to turn the question around: what factors make us believe that business cycles in the interwar period were less synchronized before WW I, and can we show that these factors were absent or, at least, less relevant, for the SEE-4? A recent summary (Ritschl&Straumann 2008) highlights three factors potentially contributing to desynchronization of business cycles in the interwar period: (1) did countries experience a recession during World War I (the standard case) or a boom (which, the

[12] As opposed to our practice for the pre-WW I period, SEE-4 shall capture henceforth Austria, Bulgaria, Romania and Yugoslavia.

authors argue, was the case for England and Italy); (2) the impact on the business cycle from tying to (in the 1920s) and untying from (in the 1930s) the gold standard; (3) did bilateral trade decrease compared to pre-WW I?

[Insert Table 11 about here]

An answer to all three questions suggests a continued (or even increased) synchronization for the SEE-4. As for the first reason, we have little reason to assume that the SEE countries deviate from the standard (continental) European pattern of a war time recession.[13] War time recessions were – as is well documented for the German case, for instance (Ritschl&Straumann 2008) – usually followed by a peak some two years later; which is exactly what we find for the SEE-4 (table 11). Second, monetary events were similar: successful stabilization efforts came very late in the 1920s (Bulgaria: Dec. 1928; Romania: Feb. 1929, Yugoslavia May 1929[14]), and the 1930s approach to exchange-rate management was similar to the German case, i.e. deflationary policies cum exchange controls without officially abandoning the gold standard (Tooze&Ivanov 2011, Nenovsky&Dimitrova 2006); third, while bilateral trade might have declined somewhat in the 1920s, it certainly rebounded in the 1930s when all SEE-4 countries found themselves increasingly tied into the German dominated Central European trading bloc (Feinstein et al. 1997). The last point is indirectly supported by the fact that Germany's correlation with the SEE-4 increases considerably from 0.26 (1919-1929) to 0.78 (1929-1939), a value higher than for England and France.

The reference to the German-led trading bloc in Central Europe also shows that high degrees of business cycle synchronization are fully consistent with the widely accepted narrative of de-globalizing world economy in the interwar period. Developments in the 1930s were simply more complex: rising protectionism *on a global scale* was accompanied by the rise of preferential trading agreements *on a regional basis*, and the quasi-universal gold standard of the late 1920s was abandoned

[13] While our calculations are confined to peacetime (table 3), we also collected many of the underlying data series for WW I. The evidence available to us suggests the standard pattern of a wartime recession.

[14] In the Yugoslav case, formal stabilization took place only in May 1931, but this was owed to rather idiosyncratic circumstances. Crucially, in 1929 central bank and treasury started working towards formally stabilizing the currency following a period of four years in which the local currency had already been fairly stable.

in favour of “currency blocs” such as the sterling area and the gold bloc. Similarly, capital controls were not applied indiscriminately vis-à-vis all countries but selectively for specific ones. The logic of this process was that members belonging to the same “trading area” or “currency bloc” might well experience increased economic integration (at the expense of the rest), thereby leading to enhanced business cycle synchronization; which is exactly what our results show for the SEE-4 plus Germany.

This interpretation is, incidentally, supported by the case of Greece which desynchronizes from the other four SEE countries when compared to the pre-WW I period. The first peak (1923) comes two to three years later than for the SEE-4, reflecting that Greece, due to the Greco-Turkish war (1919-1922), was longer tied up in military conflict. Another striking difference relates to the 1930s, where Greece reaches the trough two years after the onset of the Great Depression (in 1931), while Romania, Yugoslavia (in 1933) and Bulgaria (1934) need four and five years, respectively. This difference might well relate to the monetary factors which are often seen as particularly important in dating interwar business cycle chronology (Ritschl&Straumann 2008). As opposed to its neighbours, Greece followed the UK quickly in leaving the gold standard (April 1932), a decision which was followed by a government default in the same year. Seen from the perspective of our business cycle reconstruction, Greece opted for the better solution: the recovery came two to three years quicker, as devaluation helped improve the current account (and, in turn, GDP) more quickly than the policy alternative of deflation would have done. Our econometric findings are supportive of Tooze&Ivanov (2011) who contrast the Greek and the Bulgarian experience in the 1930s and try to explain, from a political economy perspective, why the two neighbouring countries opted for different approaches (devaluation versus deflation). More broadly speaking, our findings are also in line with Eichengreen&Sachs (1985) and Bernanke&James (1991) who showed that an early exit from the gold standard led *ceteris paribus* to a quicker recovery.

4.3 Post World War II: 1950-1989

At first glance, it might not make sense at all to extend our study into the post-WW II period; as a result of the political decisions taken at Yalta, Austria and Greece fell into the Western and Bulgaria, Romania and Yugoslavia into the Eastern camp, leaving little space for a common regional business cycle before the end of the Cold War in 1989.

We reject such reasoning on three grounds. First, even if there were no common business cycle at all, it would still be of greatest interest to see whether there was, at least, some form of business cycle synchronization among Bulgaria, Romania and Yugoslavia. We are not aware of any study into business cycle synchronization of the Soviet bloc countries but the question itself merits investigation, not least because economic integration was one of the explicit goals of Comecon, the Soviet Union-led "Committee for economic integration" which comprised of six Eastern European economies[15]: a high degree of business cycle integration would suggest that one of Comecon's goal was, at least partly, achieved.

Second, a common business cycle could be the result of common external shocks which affected both West and East. The two most likely candidates are the oil price shocks of 1973 and 1979. The impact of both shocks is well-dcoumented for Western countries but also thought to have been pronounced for the Soviet bloc countries.

Third, analyzing the SEE members of the East bloc seems of particular interest for the following reason: With Yugoslavia and Romania, SEE contained the two "unruly children" of the Soviet bloc. In turning away from the East bloc, Yugoslavia and Romania increasingly opened up towards Western Europe. Following the break with Stalin in 1949, Yugoslavia started to open economically towards the West by increasing trade and importing capital. Even the free movement of labour with the West – the prevention of which was the whole purpose of the Iron Curtain – resumed in the 1960s, as the *Gastarbeiter* experience of many Yugoslav workers in West Germany demonstrates (Lampe 2000). A similar process involved Romania, even though it started later and never proceeded as far as in the Yugoslav case. Following the oil price shock of 1973 (which, according to our calculations, hit the Soviet bloc countries on average two years later than Western countries but the impact was no less severe), Romania was forced to increase trade and obtain loans from Western

[15] The Comecon consisted of the Soviet Union, Poland, Czechoslovakia, Hungary, Romania, Bulgaria and East Germany.

countries, which, among others, led to Romania becoming a member country of the IMF in the early 1980s.

Table 12 shows business cycle integration for the period 1950 – 1972, i.e. before the first oil price shock (1973). Yugoslavia is negatively correlated with Bulgaria and Romania but exhibits positive correlation vis-à-vis the Western economies. This effect is particularly pronounced with West Germany (correlation of 0.48). Vice versa, Bulgaria and Romania themselves exhibit a positive correlation (0.56) but both are negatively correlated to Austria, Greece and West Germany. Our findings are again supported by eyeballing the data (figures 6 and 7). Bulgaria and Romania share peaks and troughs, as do Yugoslavia and Germany. The implication of this is that Yugoslavia was, as far as business cycle integration is concerned, more aligned with Western countries, notably West Germany, than with its Eastern peers.

[Insert Table 12 about here]

[Insert Table 13 about here]

[Insert Figure 6 about here]

[Insert Figure 7 about here]

Turning to the 1970s and 1980s (table 13), the correlation between West Germany and Yugoslavia remains high at 0.42. Interestingly, Romania appears to be "switching sides": while, in the 1950s and 1960s, Romania only exhibited positive values vis-à-vis Bulgaria, correlation with Bulgaria then turned negative but positive vis-à-vis Yugoslavia (0.57) and West Germany (0.34). In other words, Romania's political and economic efforts to open up towards Western Europe were accompanied by a process of business cycle synchronization with the West and business cycle dis-synchronisation with the East. This then left Bulgaria as the only genuine "East bloc" country in our sample with negative correlation values throughout.

5. Conclusion

This paper represents the first attempt ever to construct business cycle indices for the South-East European (SEE) countries from late 19th century independence to the present day. Constructing these indices allowed us to address two key questions: to what extent was there a common business cycle among the SEE countries, and to what extent was the business cycle of individual SEE countries and/or SEE as a whole synchronized with the business cycles of the major European economies, i.e. England, France, and Germany.

Business cycles are normally studied by analyzing GDP data. We first explained why historical national accounts are not necessarily well suited for this task. Our concerns partly stemmed from the idiosyncrasies of SEE GDP data, partly from general considerations as to why national historical accounts are unlikely to reflect the true but unknown GDP series. We then suggested Common Dynamic Factor Analysis (CDFA) as a promising alternative to construct business cycle indices, and based on the cases of pre-WW I England, France, Germany and Austria-Hungary – for which we have good GDP estimates which allowed direct comparison –, we demonstrated the superiority of CDFA.

The remainder of the paper was devoted to analyzing to what extent there was a common business cycle among the SEE countries, and whether the business cycle of individual SEE countries and/or SEE as a was whole synchronized with the business cycles of England, France, and Germany. We found considerable and increasing business cycle integration before World War I (both within SEE and vis-à-vis the core economies) but as part of a pan-European business cycle (rather than specific to SEE). A regional SEE business cycle (excluding Greece) emerged only in the interwar period, based on strong trade as well as similar and (almost) simultaneous monetary events. The Great Depression did not undermine the common cycle but saw a convergence with the German business cycle. The onset of the Cold War almost completely extinguished regional business cycle integration, but the increased economic links of some communist countries with the West (early on by Yugoslavia, from the mid-1970s also by Romania) also saw the re-emergence of a common business cycle vis-à-vis Austria and West Germany.

Table 1
Business cycle synchronization during the First Age of Globalization (ca. 1870-1913) according to previous research

Correlation among / between	Source	Average correlation (# of bilateral correlations)	Countries[1]	Time frame	Statistical method: correlation of
Core countries	Morgenstern (1959)	0.83 (3)	E, F, G	1870-1914	concordance index[2]
	Backus&Kehoe 1992 (table 4)	0.03 (1)	E, G	1870-1913	de-trended GDP
	Artis et al. 2011 (table 2)	0.09 (3)	E, F, G	1880-1913	de-trended GDP
	Bordo&Helbling 2011 (table 1)	0.04 (15)	E, F, G, Netherlands, Switzerland, US	1880-1913	GDP growth rates
	Bordo&Helbling 2011 (table 1)	0.09 (6)	F, G, Netherlands, CH	1880-1913	GDP growth rates
	Uebele 2011 (table 2)	0.61 (3)	E, F, G	1862-1913	CDFA business cycle indices
Peripheral countries	Backus&Kehoe 1992 (table 4)	0.29 (3)	Denm., Norway, Sweden	1865-1914[3]	de-trended GDP
	Artis et al. 2011 (table 2)	0.11 (6)	Denm., Finland, Norway, Swed.	1880-1913	de-trended GDP
	Artis et al. 2011 (table 2)	0.15 (1)	Austria-H., Greece	1880-1913	de-trended GDP
	Bordo&Helbling 2011 (table 1)	0.14 (6)	Denm., Finland, Norway, Swed.	1880-1913	GDP growth rates
Core vis-à-vis periphery	Backus&Kehoe 1992 (table 4)	0.20 (8)	E, G vis-à-vis Denm., Italy, Norway, Swed.	1861-1913[4]	de-trended GDP
	Backus&Kehoe 1992 (table 4)	0.29 (6)	E, G vis-à-vis Denmark, Norway, Swed.	1861-1913[4]	de-trended GDP
	Artis et al. 2011 (table 2)	0.04 (12)	E, F, G vis-à-vis 4 Scandinavian countries	1880-1913	de-trended GDP
	Artis et al. 2011 (table 2)	0.16 (6)	E, F, G vis-à-vis A-H., Greece	1880-1913	de-trended GDP
	Bordo&Helbling 2011 (table 1)	0.01 (60)	6 core vis-à-vis 10 peripheral[5]	1880-1913	GDP growth rates

Notes: [1] E: England; F: France; G: Germany; CH: Switzerland: A-H: Austria-Hungary.
[2] As explained in the main text (chapter 4), the concordance index cannot be directly compared to the correlation coefficient.
[3] Bilateral correlations vis-à-vis Denmark only starting in 1870.
[4] Bilateral correlations vis-à-vis Norway only starting in 1865, vis-à-vis Denmark and England in 1870.
[5] Core countries: England, France, Germany, Netherlands, Switzerland, US; peripheral countries: Australia, Canada, Denmark, Finland, Italy, Japan, Norway, Portugal, Spain, Sweden.

Sources: Provided in column 2.

Table 2
Annual data series for common dynamic factor analysis

Sectoral output indicators

#1	agricultural production
#2	communication
#3	industrial output
#4	mining
#5	construction
#6	transportation
#7	fixed investment

Fiscal indicators

#8	government expenditure
#9	government revenue

Financial indicators

#10	narrow money
#11	broad money
#12	consumer price index
#13	short term interest rate
#14	mortgage credit

Trade indicators

#15	terms of trade
#16	real effective exchange rate
#17	exports
#18	imports
#19	trade balance

Other indicators

#20	external spread
#21	foreign capital inflows
#22	foreign short term interest rate
#23	foreign output
#24	real wage
#25	population

Table 3
Estimation period and number of time series used for CDF model

Austria(-Hungary)	
1875-1913	19 time series
1919-1937	16 time series
1947-1998	18 time series
Bulgaria	
1887-1913	19 time series
1918-1940	17 time series
1960-2000	14 time series
Greece	
1875-1913	17 time series
1918-1939	17 time series
1952-2000	18 time series
Romania	
1881-1913	17 time series
1918-1941	14 time series
1955-2000	13 time series
Serbia/Yugoslavia	
1886-1912	16 time series
1919-1940	14 time series
1954-2000	15 time series
England	
1879-1913	17 time series
1921-1939	15 time series
France	
1879-1913	15 time series
1921-1939	13 time series
Germany	
1880-1913	17 time series
1921-1939	9 time series

Table 4
Common dynamic factor analysis versus historical national accounts
Business cycle correlations of England, France, Germany, Austria-Hungary 1879 - 1913

	England (CDFA)	France (CDFA)	Germany (CDFA)	AH (CDFA)	England (GDP)	France (GDP)	Germany (GDP)
France (CDFA)	0.78 ***						
Germany (CDFA)	0.81 ***	0.81 ***					
Austria-H. (CDFA)	0.67 ***	0.78 ***	0.84 ***				
England (GDP)	0.84 ***	0.66 ***	0.72 ***	0.69 ***			
France (GDP)	0.28	0.55 ***	0.35 **	0.49 ***	0.28 *		
Germany (GDP)	0.22	0.15	0.36 **	0.26	0.02	0.48 ***	
Austria-H. (GDP)	0.23	0.30 *	0.22	0.39 **	0.34 **	0.35 **	0.02

Sources: Own calculations. GDP data from Maddison (2003) for England, France and Germany and from Schulze (2000) for Austria-Hungary.

Table 5
Business cycle correlations 1879 – 1913 by country pairs:
Full period[1], 1893-1913, 1903-1913

	AH	Gr	Ro	Se	Bu	England	France	Germany
Greece	0.06 0.23 0.60 *							
Romania	0.30 * 0.31 0.51	0.26 0.33 0.45						
Serbia	0.34 * 0.55 ** 0.87 ***	0.27 0.22 0.76 **	0.19 0.32 0.64 **					
Bulgaria	0.34 * 0.28 0.03	-0.07 -0.25 -0.45	0.27 0.37 * 0.22	0.42 ** 0.25 0.15				
England	0.67 *** 0.49 ** 0.45	0.25 0.37 0.49	0.13 0.07 0.29	0.24 0.09 0.36	-0.07 -0.29 -0.55 *			
France	0.78 *** 0.85 *** 0.88 ***	0.23 0.12 0.59 *	0.17 0.19 0.56 *	0.48 ** 0.46 ** 0.70 **	0.25 0.08 -0.19	0.78 *** 0.66 *** 0.73 **		
Germany	0.84 *** 0.83 *** 0.78 ***	0.08 0.25 0.57 *	0.19 0.23 0.59 *	0.34 * 0.42 ** 0.73 **	0.18 0.07 -0.18	0.81 *** 0.77 *** 0.84 ***	0.81 *** 0.86 *** 0.87 ***	

Notes: Entries are bilateral correlations of the cyclical component (as computed according to the description in the main text). The first entry in each cell refers to the full period and the second and the third entries refer to 1893-1913 and 1903-1913, respectively. *, ** and *** denote statistical significance levels of 10%, 5% and 1%, respectively.
[1] The full period is given by pair-wise intersection of the estimation period (table 3), i.e., it might differ between country pairs.

Sources: Cf. main text.

Table 6
Business cycle correlations 1879 – 1913 (summary statistics)
Full period, 1893-1913, 1903-1913

	AH	Gr	Ro	Se	Bu	England	France	Germany
Summary statistics for SEE-5								
Average r	0.26	0.13	0.26	0.30	0.24	0.25	0.38	0.32
vis-à-vis	0.34	0.13	0.34	0.34	0.17	0.15	0.34	0.36
SEE-5	0.50	0.34	0.45	0.61	-0.01	0.21	0.51	0.50
	0.24 0.26 0.38					0.32 0.28 0.40		
Average r	0.76	0.19	0.17	0.35	0.12			
vis-à-vis	0.72	0.25	0.16	0.33	-0.04			
E, F, G	0.70	0.55	0.48	0.60	-0.31			
	0.32 0.28 0.40							
Summary statistics for SEE-5 and England, France, Germany (28 bilateral correlations)								
Average r	0.34 0.33 0.44							

Summary statistics for SEE-4 (Austria-Hungary, Greece, Romania, Serbia)								
Average r	0.23	0.20	0.25	0.26		0.32	0.41	0.36
vis-à-vis	0.36	0.26	0.32	0.36		0.25	0.41	0.43
SEE-4	0.66	0.60	0.53	0.76		0.40	0.68	0.67
	0.24 0.33 0.64					0.37 0.37 0.58		
Average r	0.76	0.19	0.17	0.35				
vis-à-vis	0.72	0.25	0.16	0.33				
E, F, G	0.70	0.55	0.48	0.60				
	0.37 0.37 0.58							
Summary statistics for SEE-4 and England, France, Germany (21 bilateral correlations)								
Average r	0.39 0.41 0.63							

Bulgaria excluded (cf. main text)

Notes: Entries are bilateral correlations of the cyclical component (as computed according to the description in the main text). The first entry in each cell refers to the full period and the second and the third entries refer to 1893-1913 and 1903-1913, respectively.

Table 7
Wilcoxon rank sum test for equality of correlations across periods

Countries (# of bilateral correlations)	Median correlation coefficient (average correlation coefficient)			Difference of medians across periods [p value based on Wilcoxon rank sum test]	
	1879-1913	1893-1913	1903-1913	1879-1913 vs. 1903-1913	1893-1913 vs. 1903-1913
SEE-5 & core (28)	0.27 (0.34)	0.30 (0.33)	0.56 (0.44)	0.29 [0.08]	0.26 [0.07]
SEE-4 & core (21)	0.27 (0.39)	0.33 (0.41)	0.60 (0.63)	0.33 [0.00]	0.27 [0.00]
SEE-5 (10)	0.27 (0.24)	0.30 (0.26)	0.48 (0.38)	0.21 [0.24]	0.18 [0.42]
SEE-4 (6)	0.27 (0.24)	0.32 (0.33)	0.62 (0.64)	0.35 [0.01]	0.30 [0.01]
Core (3)	0.81 (0.80)	0.77 (0.76)	0.84 (0.81)	0.03 [0.66]	0.07 [0.66]
SEE-5 vis-à-vis core (15)	0.24 (0.32)	0.23 (0.28)	0.56 (0.40)	0.32 [0.16]	0.33 [0.13]
SEE-4 vis-à-vis core (12)	0.25 (0.37)	0.31 (0.37)	0.58 (0.58)	0.33 [0.03]	0.27 [0.02]

Sources: Cf. main text.

Table 8
Business cycle correlations 1919 – 1941 by country pairs:
1919 – 1941, 1919 – 1929, 1929 - 1941

	Au	Bu	Ro	Yu	Gr	England	France	
Bulgaria	0.59 ***							
	0.75 ***							
	0.59 *							
Romania	0.68 ***	0.71 ***						
	0.75 ***	0.80 ***						
	0.90 ***	0.63 **						
Yugoslavia	0.79 ***	0.72 ***	0.82 ***					
	0.70 **	0.91 ***	0.81 ***					
	0.92 ***	0.63 **	0.97 ***					
Greece	-0.09	0.14	0.19	0.24				
	0.07	0.31	0.23	0.39				
	-0.10	0.19	0.32	0.26				
England	0.51 **	0.46 **	0.41 *	0.56 **	0.29			
	0.46	0.58	0.12	0.38	0.03			
	0.58	0.52 *	0.68 **	0.71 **	0.57 *			
France	0.49 **	0.22	0.32	0.51 **	0.08	0.51 **		
	-0.29	0.06	-0.26	-0.09	-0.13	0.32		
	0.65 *	0.39	0.66 **	0.79 ***	0.26	0.58 *		
Germany	0.54 **	0.26	0.42 *	0.46 **	-0.05	0.56 **	0.34	
	0.49	0.22	0.14	0.20	-0.32	0.53	0.02	
	0.77 *	0.52	0.93 ***	0.89 ***	0.54 *	0.75 ***	0.66 **	

Notes: Entries are bilateral correlations of the cyclical component (as computed according to the description in the main text). The first, second and third entry in each cell refer to 1919-1941, 1919-1929 and 1929-1941, respectively. Periods might be shorter, depending on the estimation period (table 3). *, ** and *** denote statistical significance levels of 10%, 5% and 1%, respectively.

Sources: Cf. main text.

Table 9
Business cycle correlations 1919 - 1941 (summary statistics)
1919 – 1941, 1919 – 1929, 1929 - 1941

	Au	Bu	Ro	Yu	Gr	England	France	Germany
Summary statistics for SEE-5								
Average r	0.49	0.54	0.60	0.64	0.12	0.44	0.32	0.32
vis-à-vis	0.57	0.69	0.65	0.70	0.25	0.31	-0.14	0.15
SEE-5	0.58	0.51	0.71	0.69	0.17	0.61	0.55	0.73
	0.48 0.57 0.53					0.36 0.11 0.63		
Average r	0.51	0.31	0.38	0.51	0.11			
vis-à-vis	0.22	0.29	0.00	0.16	-0.14			
E, F, G	0.66	0.48	0.76	0.80	0.45			
	0.36 0.11 0.63							
Summary statistics for SEE-5 and England, France, Germany (28 bilateral correlations)								
Average r	0.42 0.29 0.60							

Summary statistics for SEE-4 (Austria, Bulgaria, Romania, Yugoslavia)								
Average r	0.69	0.67	0.74	0.78		0.48	0.38	0.42
vis-à-vis	0.73	0.82	0.79	0.81		0.38	-0.15	0.26
SEE-4	0.80	0.62	0.83	0.84		0.62	0.62	0.78
	0.72 0.79 0.77					0.43 0.17 0.67		
Average r	0.51	0.31	0.38	0.51				
vis-à-vis	0.22	0.29	0.00	0.16				
E, F, G	0.66	0.48	0.76	0.80				
	0.43 0.17 0.67							
Summary statistics for SEE-4 and England, France, Germany (21 bilateral correlations)								
Average r	0.52 0.36 0.70							

Greece excluded (cf. main text)

Notes: Entries are bilateral correlations of the cyclical component (as computed according to the description in the main text). The first, second and third entry in each cell refer to 1919-1941, 1919-1929 and 1929-1941, respectively.

Table 10
Wilcoxon rank sum test for equality of correlations across periods

Countries (# of bilateral correlations)	Median correlation coefficient (average correlation coefficient)			Difference of medians across periods [p value based on Wilcoxon rank sum test]
	1919-1929	1929-1941	1919-1941	1919-1929 vs. 1929-1941
SEE-5 & core (28)	0.27 (0.29)	0.63 (0.60)	0.46 (0.42)	0.36 [0.00]
SEE-4 & core (21)	0.38 (0.36)	0.66 (0.70)	0.51 (0.52)	0.28 [0.00]
SEE-5 (10)	0.72 (0.57)	0.61 (0.53)	0.64 (0.48)	-0.11 [0.85]
SEE-4 (6)	0.78 (0.79)	0.76 (0.77)	0.71 (0.72)	-0.02 [0.94]
Core (3)	0.32 (0.29)	0.66 (0.67)	0.51 (0.47)	0.34 [0.08]
SEE-5 vis-à-vis core (15)	0.12 (0.11)	0.65 (0.63)	0.42 (0.36)	0.53 [0.00]
SEE-4 vis-à-vis core (12)	0.17 (0.17)	0.67 (0.67)	0.46 (0.43)	0.50 [0.00]

Sources: Cf. main text.

Table 11
Turning points of South-East European business cycles, 1919 - 1941

	Austria	Bulgaria	Romania	Yugoslavia	Greece
1st peak	1920	1920	1920	1921	1923
1st trough	1927	1926	1926	1927	1926
2nd peak	1930	1929	1929	1929	1929
2nd trough	1933	1934	1933	1933	1931
3rd peak	1937[1]	1937	1937	1937	1934

Notes: [1] The Austrian data ends in 1937 (cf. table 3).

Sources: Own calculations as described in the main taext.

Table 12
Bilateral correlations of cyclical component 1950-1972

	Au	Bu	Gr	Ro	Yu	England	France	Germany
Austria	1.00					0.35	0.75	0.61
Bulgaria	-0.20	1.00				-0.21	-0.54	-0.54
Greece	0.60	0.21	1.00			0.43	0.28	0.48
Romania	-0.18	0.56	-0.20	1.00		0.34	-0.12	-0.30
Yugoslavia	0.10	-0.70	-0.06	-0.31	1.00	0.26	0.11	0.48

Sources: Cf. main text.

Table 13
Bilateral correlations of cyclical component 1972-1988

	Au	Bu	Gr	Ro	Yu	England	France	Germany
Austria	1.00					-0.33	0.28	0.20
Bulgaria	0.02	1.00				-0.14	-0.38	-0.39
Greece	0.25	-0.18	1.00			0.40	0.47	0.49
Romania	0.36	0.26	0.10	1.00		0.14	-0.11	0.34
Yugoslavia	0.15	-0.12	-0.37	0.57	1.00	0.13	0.05	0.42

Sources: Cf. main text.

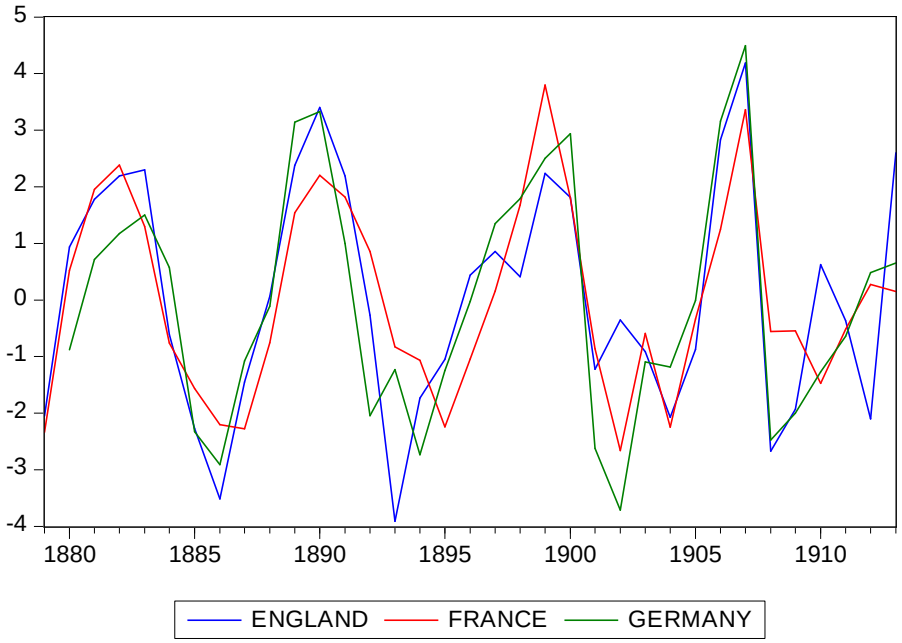

Figure 1: Business cycles of England, France and Germany, 1879 - 1913.

Source: Own calculations based on data as described in the main text.

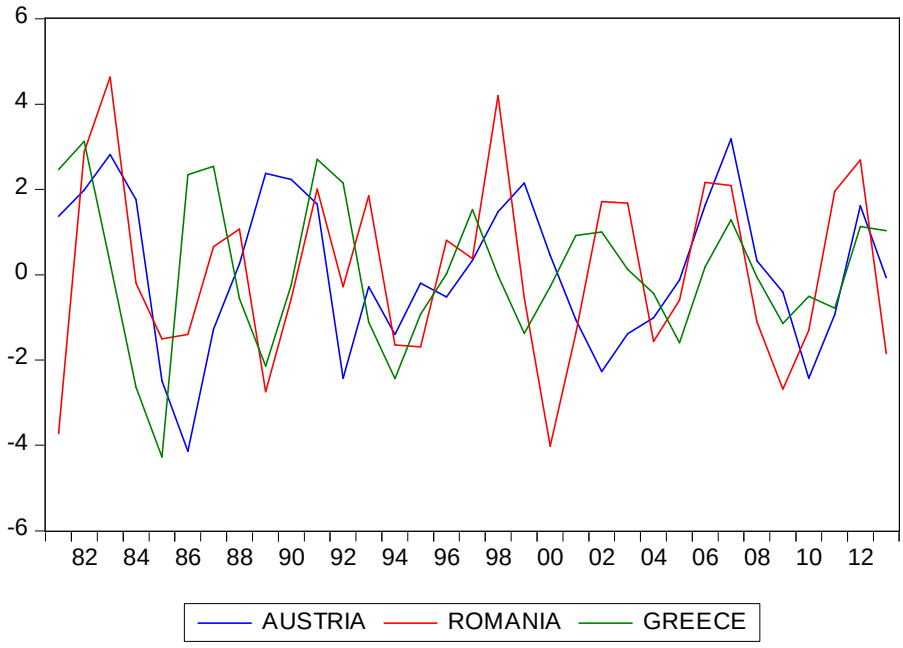

Figure 2: Business cycles of Austria, Greece and Romania, 1881 - 1913.

Source: Own calculations based on data as described in the main text.

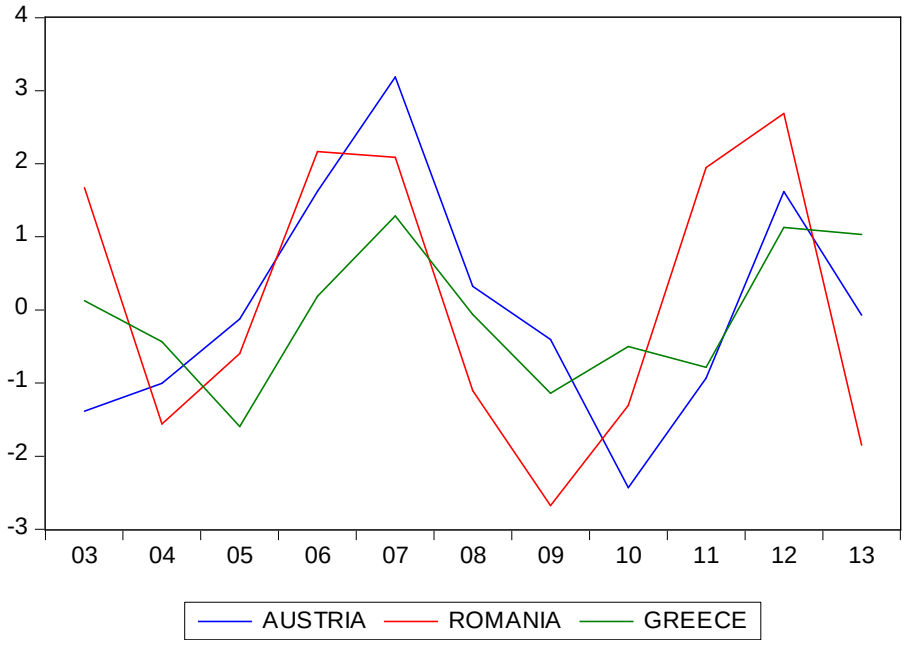

Figure 3: Business cycles of Austria, Greece and Romania, 1903 - 1913.

Source: Own calculations based on data as described in the main text.

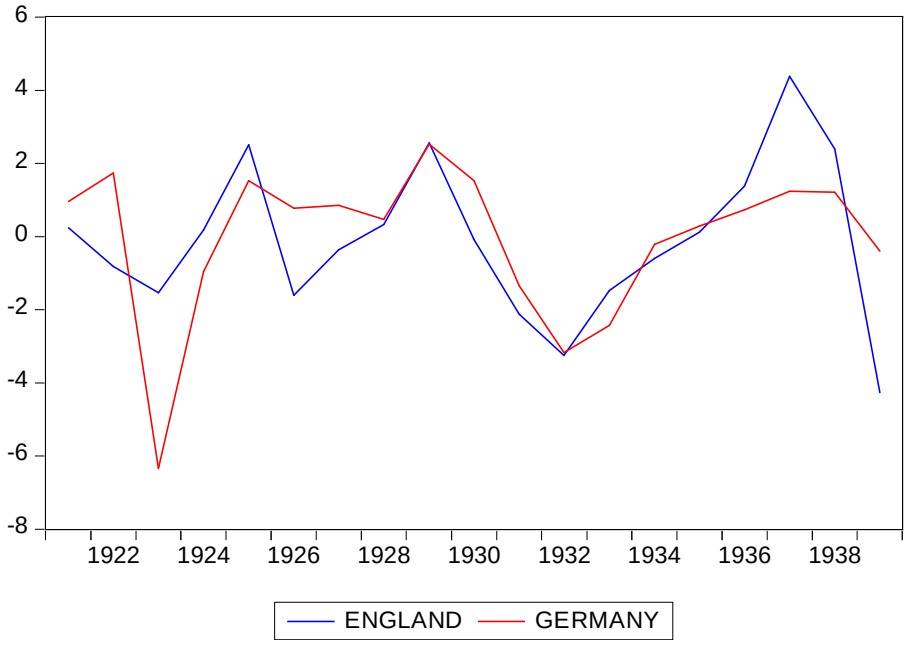

Figure 4: Business cycles of England and Germany, 1921 - 1939.

Source: Own calculations based on data as described in the main text.

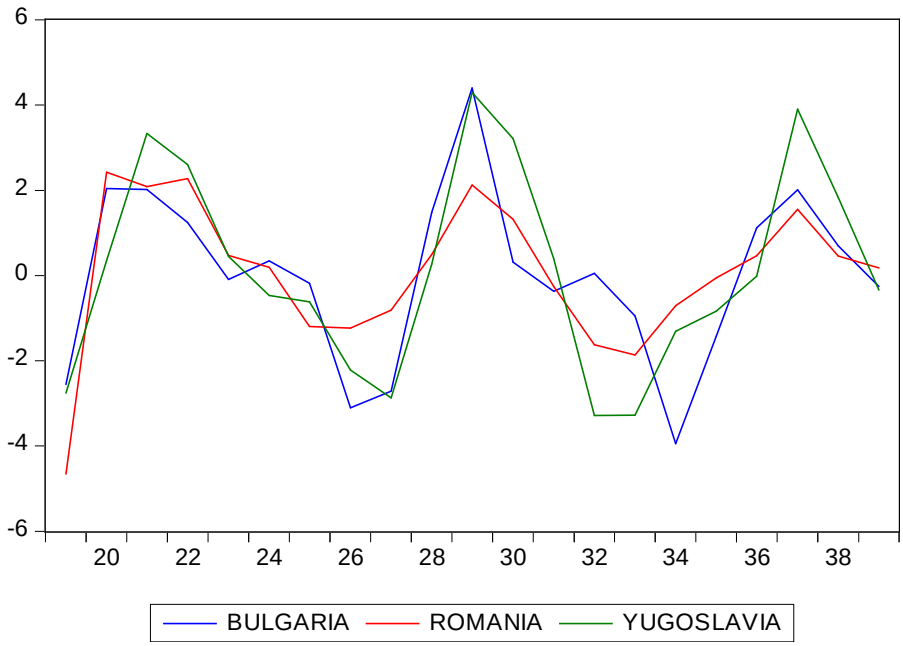

Figure 5: Business cycles of Bulgaria, Romania and Yugoslavia, 1919 - 1939.

Source: Own calculations based on data as described in the main text.

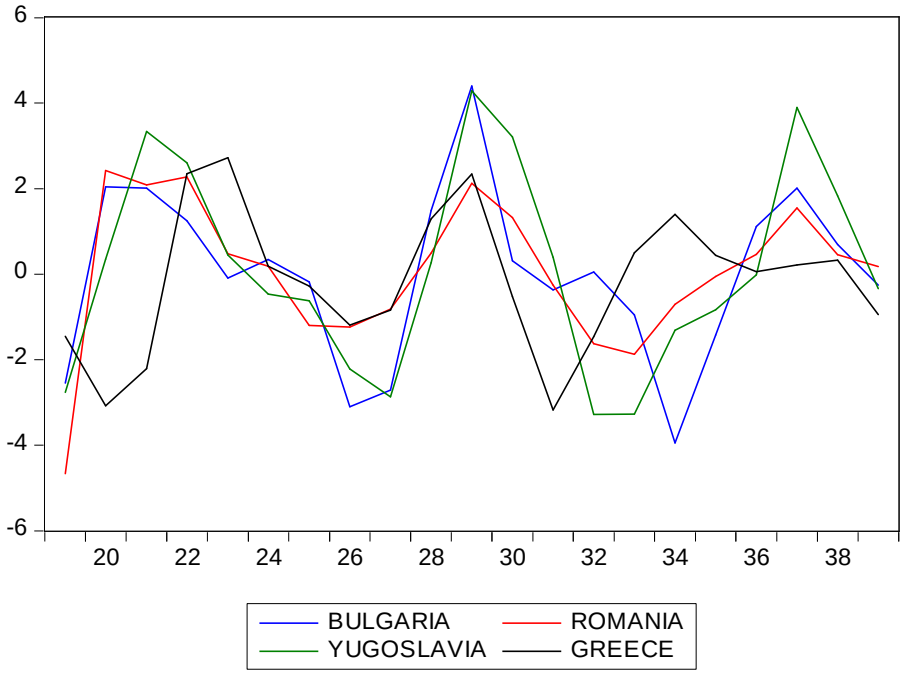

Figure 6: Business cycles of Bulgaria, Greece, Romania and Yugoslavia, 1919 - 1939.

Source: Own calculations based on data as described in the main text.

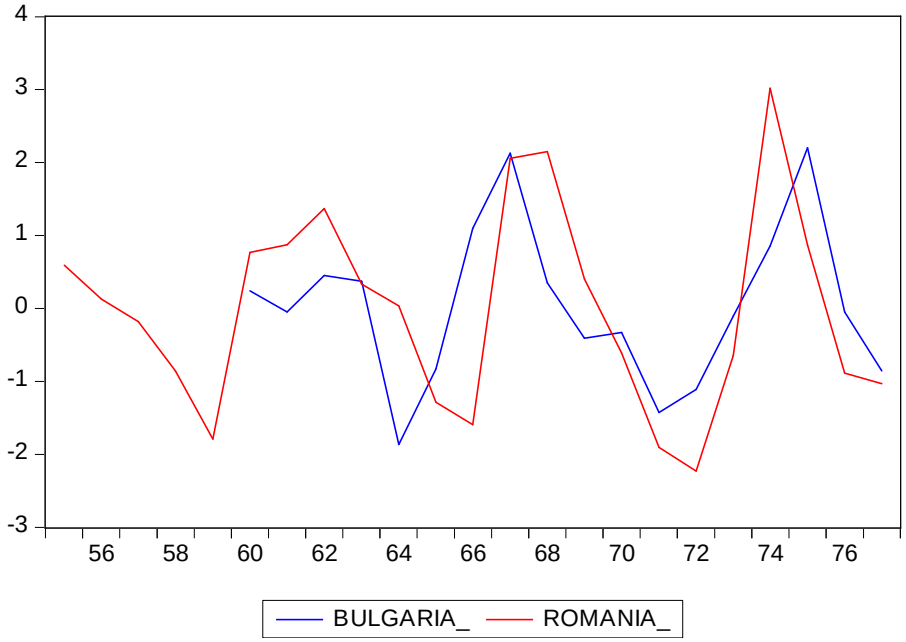

Figure 7: Business cycles of Bulgaria and Romania, 1955-1977.

Source: Own calculations based on data as described in the main text.

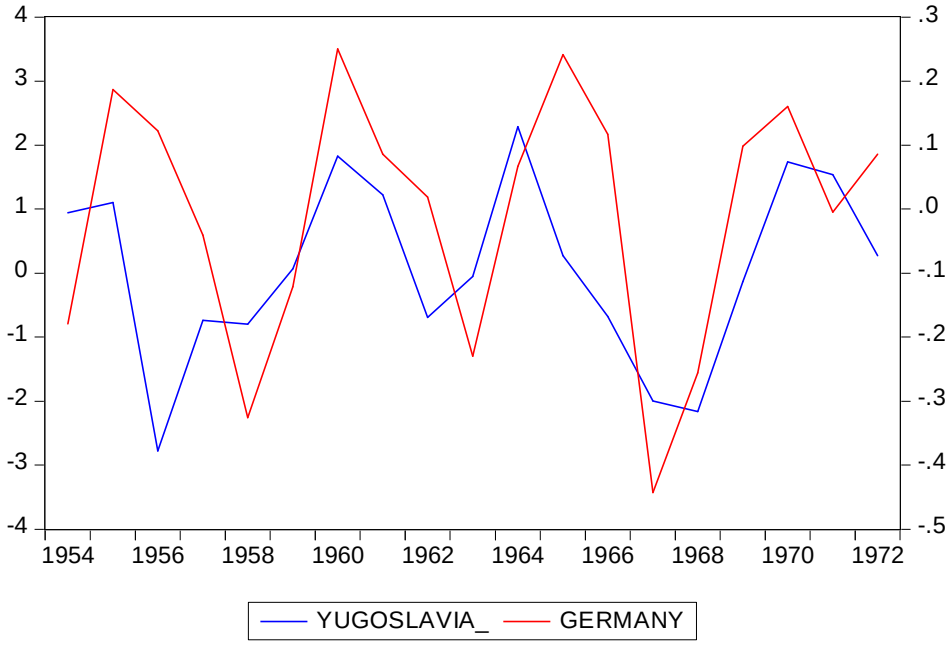

Figure 8: Business cycles of Yugoslavia and Germany, 1954-1972.

Source: Own calculations based on data as described in the main text.

Data Appendix

Austria(-Hungary), Bulgaria, Greece, Romania, Serbia/Yugoslavia

The main source for all five SEE countries is the respective official *Statistical Yearbook* (publication of which started shortly after obtaining political independence in the 19th century). In the following, we provide information for those time series where other sources were used.

Numbers for individual time series follow the numbers as given in table 2.

Austria-Hungary

1, 3, 4, 5	kindly communicated by Schulze
7	Schulze (2008)
10	kindly communicated by Austrian National Bank
11	Komlos (1987)
12	Muehlpeck et al. (1979)
15, 16	own calculations based on variety of sources (detailed description upon request)
20	own calculations based on Bunzl (1914)
21	Morys (2006)
25	kindly communicated by Schulze

Austria: interwar period

1, 3, 5, 6	Kausel et al. (1965)
8 – 13	Butschek 1999
15, 16	own calculations based on variety of sources (detailed description upon request)
17, 18	Butschek 1999
20, 21	League of Nations Statistical Yearbook
25	Butschek 1999

Austria: post-WW II

1 – 13	Butschek 1999
16	International Financial Statistics
17-21, 24, 25	Butschek 1999

Bulgaria: pre-WW I and interwar period

1, 3, 5	GDP calculations by Ivanov
10, 11	kindly communicated by Bulgarian National Bank
12	own calculations based on variety of sources (detailed description upon request)
13	kindly communicated by Bulgarian National Bank
15, 16	own calculations based on variety of sources (detailed description upon request)

Bulgaria: post-WW II

15	Vienna Institute for International Economic Studies Yearbook

Greece: pre-WW I and interwar period

3 – 6	Kostelenos et al. (2007)
8	kindly communicated by Kostelenos
9	kindly communicated by Bank of Greece
10, 11	Kostelenos et al. (2007)
12, 13	kindly communicated by Bank of Greece
15, 16	own calculations based on variety of sources (detailed description upon request)
17, 18	kindly communicated by Kostelenos
20	kindly communicated by Tuncer
25	Kostelenos et al. (2007)

Greece: post-WW II

7-18, 21, 24, 25	International Financial Statistics

Romania: pre-WW I and interwar period

12, 15, 16	own calculations based on variety of sources (detailed description upon request)

Romania: post-WW II

10, 12, 15, 21	Vienna Institute for International Economic Studies Yearbook

Serbia (pre-WW I) and Yugoslavia (interwar period)

8, 9	Sundhausen (1989)
10, 11	kindly communicated by National Bank of Serbia
12	own calculations based on variety of sources (detailed description upon request)
13	kindly communicated by National Bank of Serbia
15, 16	own calculations based on variety of sources (detailed description upon request)
17, 18	Sundhausen (1989)

Yugoslavia: post-WW II

10, 11	kindly communicated by National Bank of Serbia
15	Vienna Institute for International Economic Studies Yearbook

England, France, Germany

The main reference for England, France and Germany is Mitchell (2007). In the following, we provide information for those time series where other sources were used.

Numbers for individual time series follow the numbers as given in table 2.

England

7	Feinstein (1972)
11	Capie&Webber (1985)
13	Hawtrey (1962) and League of Nations Statistical Yearbook
16	Solomou&Catao (2000)

France

13	Hawtrey (1962) and League of Nations Statistical Yearbook
16	Solomou&Catao (2000)

Germany

5, 7	Hoffmann (1965)
13	Reichsbank Annual Reports and League of Nations Statistical Yearbook
16	Solomou&Catao (2000)

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