Business Cycles in the Nordic countries 1834 – 1950:
Balancing domestic and external forces

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Abstract
Based on a freshly built data set and relying on a Dynamic Factor Model, this paper constructs business cycle indices for four Nordic countries (Denmark, Finland, Norway and Sweden) to address three questions: To what extent was there a common Nordic business cycle? Was there synchronisation of business cycles with England, France and Germany? Was the business cycle predominantly driven by external forces or by domestic forces? As opposed to earlier research, we find that a specific Nordic business cycle emerged only in the interwar period. Before WW I, synchronization levels increase over time both internally and vis-à-vis the core countries, suggesting participation in a pan-European business cycle. The interwar period witnesses the fragmentation of a pan-European business cycle, but the shared experiences of the Nordic countries (world war I boom due to neutrality, early re-adoption of the gold standard in the 1920s and simultaneous shift to the sterling bloc in 1931, no trade disintegration) mean that the dis-synchronizing forces were not at work in this part of Europe.

Keywords: Nordic countries business cycle, national historical accounts, common dynamic factor analysis

JEL classification: N13, N14, C43, E32

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1. Introduction

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 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.

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\(^1\) 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.

\(^2\) 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.
In this paper, we will follow the CDFA approach. We reconstruct the business cycles of four Nordic countries, namely Denmark, Finland, Norway and Sweden. We will then address three main questions: to what extent was there a common Nordic business cycle? Was there synchronisation of business cycles with England, France and Germany? Was the business cycle predominantly driven by external forces or by domestic forces?

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 four 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), one affirmative (Aiolfi et al. 2011) and one somewhere in between (Bergman and Jonung 2011). Bergman and Jonung’s study is similar to ours, in the sense that they investigate the presence business cycle synchronization in the three Scandinavian countries (Sweden, Norway, Finland) 1834-2008, and found it to be increasing during the period of the Scandinavian Currency Union (SCU, 1873-1913). However, relating to the issue of regional business cycles, they also find that the average correlation between the Scandinavian countries is of a similar magnitude as correlation with UK, and find no significant evidence in favour of a strong regional business cycle. The main difference between our study and Bergman and Jonung (2011) is that they use de-trended GDP data for the cyclical component, while our study relies on CDFA methodology. As we will explain in section 2, there are reasons to be sceptical about GDP data in business cycle analysis, and the time series properties of the GDP data used for the Scandinavian countries is likely to be gradually improving since 1834 which may potentially influence the results. Still, the Nordic countries constitute an interesting case study of regional business cycles. First of all, they share a common history going back to the Kalmar Union between the kings of Sweden-Finland, Norway and Denmark in 1397. Although Sweden-Finland fought its way out of the union in 1523, Norway stayed under Danish crown until the Napoleonic wars. Similarly, Finland was captured by tsarist Russia in 1809 and became and autonomous grand Duchy of Russia until independence in 1917. Importantly, the political and institutional system that had been in force during the

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3 However, in a previous study, Bergman, Gerlach and Jonung (1992) have found evidence of a Nordic business cycle 1870-1988.
Swedish rule remained intact in Finland during the Russian period. After Sweden lost Finland to Russia, they formed a political union with Norway that lasted until 1905. Also, Sweden, Norway and Denmark formed the Scandinavian Currency Union (SCU) in 1873. The SCU treaty only concerned monetary aspects, leaving trade outside the agreement. Thus, tight links tie these four countries together in various constellations throughout history.

Secondly, the Nordic countries have always been open to trade, both with each other, and the rest of the world. In fact, the dominant explanation of industrialization in these countries is that it was by and large a response to foreign demand in products such as timber, iron ore, oat, dairy and pork and occurred during the mid 19th century (e.g. Jörberg 1973 and Hodne 1988, 1994).

Thirdly, the data sources from the Nordic countries are of exceptional quality given their peripheral and agricultural status during the 19th century. For example, the first population Census in Sweden-Finland was carried out as early 1749 and was updated regularly, meaning that Sweden and Finland have the world’s longest continuous population accounts. Similarly, we are able to use data from official accounts and industrial censuses to obtain yearly series for many economic indicators back to at least the 1830s. Thus, using data from the Nordic countries, we are able to study the emergence of business cycles and their synchronization with the rest of the world using time series that starts before the actual process of industrialisation remain uninterrupted throughout the process of increasing globalisation and trade and the two world wars.

The fact that we have uninterrupted data also helps us to analyse how volatile and how persistent have business cycles been across countries and over time? Romer (1986, 1989) revealed the established wisdom of high 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.

4 The data from the national census in 1749 were completed in 1755 and delivered to the King. According to the census, the population of the kingdom amounted to 2,175,124 inhabitants, of whom 410,400 lived in the Finnish territory. The population was far less than expected and the data was therefore kept secret.
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. 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 Nordic business cycle, and has there been synchronisation of business cycles with England, France and Germany? In the fifth section we will explain the debate on internal versus external forces in the economic development of the Nordic countries and, more specifically, as it relates to the business cycle. The six 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.

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.  

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).

[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).

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%.

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5 For a more detailed comparison of both techniques cf. Ritschl et al. (2008) and Aiolfi et al. (2006).
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:

\[
(1) \quad y_t = \lambda_0 + \lambda f_t + \varepsilon_t
\]

\[
\begin{align*}
\text{(n x 1)} & & \text{(n x 1)} & & \text{(n x o)} & & \text{(o x 1)} & & \text{(n x 1)} \\
\end{align*}
\]

\(y_t\) is a \((n \times 1)\) vector of variables \(y_{it}\) with \(i = 1\) to \(n\) (with \(n = 25\) in our case) and \(t = 1830\) to \(1950\). 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 \((o \times 1)\) 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 \((n \times o)\) matrix \(\lambda\) – may differ in different rows). The third summand – i.e., the different \(\varepsilon_i\)’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.

\[
(2) \quad y_{it} = \lambda_{0i} + \lambda_i f_t + \varepsilon_{it}
\]

\[
\begin{align*}
\text{(1 x 1)} & & \text{(1 x 1)} & & \text{(1 x o)} & & \text{(o x 1)} & & \text{(1 x 1)} \\
\end{align*}
\]

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 \(\varepsilon_{it}\) follows a AR\((q)\) process. To emphasize the different nature of the autoregressive process (vector versus scalar), we choose \(\Phi (o \times o)\) and \(\varphi (\text{scalar})\), respectively.
\[
\begin{align*}
(3) \ f_t &= \Phi_1 f_{t-1} + \Phi_2 f_{t-2} + \ldots + \Phi_p f_{t-p} + \zeta_t \\
&(\text{all variables are scalars})
\end{align*}
\]

The model requires several identifying assumptions, the most important of which is that we assume \( \zeta_t \) to be i.i.d. \( N(0, I_n) \). For more details cf. Koop&Korobilis (2010: 52-53).

We interpret the first factor (i.e., the first element of the \((o \times 1)\) 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.

Calculations were carried out with Matlab relying on a code developed by Koop and Korobilis.\(^6\) \( p \) 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

\(^6\) 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](http://personal.strath.ac.uk/gary.koop/bayes_matlab_code_by_koop_and_korobilis.html)
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.

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 4 Nordic countries and 3 core countries for the entire period of 1830s to 1950.

[Insert Table 2 about here]

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, how do our CDFA findings compare to previous research on the Nordic countries that is not reliant on GDP but a broader set of indicators?

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 (Finland before 1860, 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 Finland). This finding vindicates the somewhat eclectic approach of CDFA which relies on a large number of time series.

**CDFA versus Jörberg (1961)**

In 1961 professor Lennart Jörberg, published his book *Growth and Fluctuations of Swedish Industry 1869-1912*. The ambition in this book was to present “a general survey of the Swedish industrialisation process, with the emphasis on a description, based on economic statistics, of the development and fluctuations of industry” (Jörberg, 1961, p. 5). The book describes the growth and diversification of Swedish industry and a major part of it (part four) consists of a detailed analysis of the dependency of industry on the business cycle, by dividing the period into five “reference cycles” between 1869 and 1912. The starting year of the analysis is partly due to data considerations and partly to the belief that business cycles was a purely industrial phenomenon. Although Jörberg accepted that agriculture could have a decisive influence on the business cycle by affecting the demand for industrial goods “particularly in a society in which the greater part of the population live on agriculture, as was the case in Sweden during the period now examined”, he states that the modern business cycle “is an industrial phenomenon and therefore industry should be the primary subject of a study of these cycles” (Jörberg, 1961, p. 216).

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7 Jörberg devotes appendix 1 of his book (pages 367-382) to a detailed scrutiny of the reliability of the Swedish industrial statistics as reported by the official statistical agencies. In this appendix, he argues that the reorganisation of the industrial statistics in 1863 involved a considerable improvement in its quality.
In identifying his reference cycles, Jörberg, uses a simplification of the methodology carried out by the NBER, in which peaks and troughs were identified on the basis of variations in statistical series with no trend elimination. Jörberg statistical material consisted of 96 and 180 series of various industrial indicators, the smallest number in the beginning of the period and the most towards the end (Jörberg, 1961, p. 217). In addition to the statistical material, Jörberg used qualitative reports, such as letters and memoranda by businessmen and trade journal and company monographs to determine the general troughs. Taken together the period 1869-1912 was divided into five “reference cycles” with troughs in 1869, 1879, 1887, 1893, 1901 and 1909 (Jörberg, p. 218-19).

Interestingly, the CDFA indicator, displayed in figure x, identified the following troughs: 1871, 1879, 1887, 1893, 1903/5 and 1909. Thus, out of six troughs, the CDFA and Jörberg’s reference cycle coincides exactly in four cases. Only in two instances are the troughs identified by the CDFA occurring two years later that the troughs in Jörberg’s reference cycle (1869 vs. 1871 and 1901 vs. 1903). For our purposes, it is interesting to note that our methodology, which relies on completely different data and methodological principles to Jörberg, still delivers such close results for the investigated period. Actually, it is not surprising that in those two instances when the methods actually yield differing results, the CDFA-indicator tends to deliver troughs later than the purely industrially-oriented indicator suggested by Jörberg. Because Swedish industry is so export-dominated, it seems reasonable that certain down-swings could enter earlier into troughs in the industrial indicators and then spread to the rest of the economy after a year or two.

The five business cycles identified in Jörberg are given the following characteristics. The first cycle (1869-1879) largely corresponds to the break-through for Swedish industry in and international context. Jörberg explains the business cycle upswing by a boom in leading industrial economies which led to an increase in the typical Swedish export goods timber, iron and oats. The Depression at the end of the 1870s was the most spectacular of all contractions (see the pronounced trough in 1879 in figure x), and according to Jörberg this was an international depression that hit Sweden “some years after it had made itself into the leading industrial countries” (Jörberg, p. 225). The explanation for the retarded Swedish response to international conditions is given by internal forces that favoured continued expansion, such as the railroads
investments and construction of housing to accommodate an increasing urban population.

The following cycle (1879-1887, as identified exactly by both Jörberg and the CDFA indicator) refers to the ‘unknown’ decade in Swedish economic history (Jörberg 1961, p. 249). That dramatic upswing of the 1870s and the similar rapid economic expansion of the 1890s were in contrast to the uneventful 1880s. Contemporary opinion saw the 1880s as hard times, probably influenced by the mass emigration from Sweden that reached a pronounced peak during the decade and by the fact that railroad expansion markedly slowed down.
4. Business Cycles in the Nordic countries, 1834 - 1950

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 Fourier 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: 1830s - 1913
Table 5 shows business cycle synchronization among the seven countries under investigation, i.e. the Nordic 4 and England, France and Germany. For each country pair we provide correlations for three different periods: 1830s – 1850, 1850-1870 and 1870-1913. 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.

[Insert Table 5, 6 about here]

[Insert Figure 2 about here]

Tables 5 and 6 reveal an increase in business cycle synchronisation the closer we move to WW I. The average correlation of the four Nordic countries increases from 0.21 (1830s – 1850) over 0.44 (1850 – 1870) to 0.73 (1870-1913).

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)\(^8\), 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).

This average measure, however, obfuscates the fact that most of the increase in business cycle synchronisation from the second to the third period is driven by Finland which until the 1870s appears somewhat apart from Denmark, Norway and Sweden. If we confine our analysis to the three Scandinavian countries (Denmark, Norway and Sweden), we see that most of the increase occurred between the first and the second period, with the average value rising 19\% from the first to the second period but only a further 9\% from the second to the third.

[Insert Figures 3, 4 about here]

Distinguishing between the three periods, then, has three main implications: First, the process of industrialisation – which is seen as gaining substantial momentum in

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\(^8\) The only exception they find relates to the transition from the interwar to the Bretton Woods period where synchronization levels hardly change.
the 1850s in the cases of Denmark, Norway and Sweden – resulted in increased synchronisation. This reasoning is supported indirectly by Finland remaining apart until the 1870s due to its delayed industrialisation.

Second, the high levels of synchronisation achieved in mid-century did not increase further after 1870. This finding contradicts an earlier literature which has argued that specific events occurring at this time, most notably the foundation of the Scandinavian Currency Union (1873), increased synchronisation levels even further (Bergman and Jonung 2011); rather, it seems that pre-existing high synchronisation levels were a key factor in launching and, later, successfully running such a monetary arrangement.

Third, our results also speak to the debate on regional business cycles before WW 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 Nordic countries are as much synchronized among each other as vis-à-vis England, France and Germany. Rather than referring to a regional Nordic business cycle, it seems more accurate to see Nordic countries increasingly participating in a pan-European business cycle emanating from the core countries.
4.2 Interwar period: 1919 – 1939

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 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 distinguish between the two.

[Insert Tables 7, 8 about here]

[Insert Figure 5 about here]

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. This value is identical to the average correlation value of England, France and Germany vis-à-vis the Nordic countries. By contrast, business cycle synchronisation among the
four Nordic countries continues in the interwar period at levels very similar to the decades preceding WW I. Given our earlier definition of a “regional business cycle”, our results show that the interwar period sees the emergence of a Nordic business cycle involving Denmark, Finland, Norway and Sweden.

What then explains the emergence of a regional business cycle in the interwar period? 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 Nordic-4? A recent summary (Ritschl&Straumann 2010) 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; (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?

An answer to all three questions suggests a continued (or even increased) synchronization for the Nordic-4. Firstly, the Nordic countries remained neutral during WW I and experienced a wartime boom, a phenomenon typically observed for neutral countries during and in the immediate aftermath of World War I (Ritschl&Straumann 2010). All Nordic countries experience a trough in 1914 and a peak in 1920. During the WW1, the Allies, primary Britain blockaded trade with war material with Germany and Austria-Hungary, which meant that the neutral Nordic countries saw an increasing demand for strategically important products such as iron ore, steel and certain engineering items such as ball bearings. For example, Swedish exports volumes rose by 60 per cent between 1910 and 1915, thereafter exports volumes decreased slightly in Sweden, while Denmark and Norway experienced a sharp increase.

Second, monetary events in the interwar period were similar: successful stabilisation efforts came early in the 1920s (Sweden was Europe-wide the first country to stabilise as early as 1922, cf. Straumann 2012, p. 25), largely as a result of a much smaller monetary overhang due to the absence of a war effort relying on

---

9 Although neutral in the First World War, the Finnish experience is however somewhat different since it became independent from Russia in 1917 and was thrown into a Civil War in 1918. The Civil War halted industrial production and increased money supply and inflation.

10 The different stages of export increases during the First World War eventually lead to the monetary tensions that were to cause the fall of the Scandinavian Currency Union according to Bergman et al. (1993).
monetary financing. The return to gold did not occur simultaneously for all countries, but, crucially, the efforts needed to go back to gold were not so severe that they resulted in serious recessions in the way they did in other countries in the 1920s (most notably in the UK with its two recessions in 1918-1921 and 1925-26 which were both induced by the UK attempts to return to gold at the old but much overvalued parity, cf. Morys 2013). Monetary events also went in parallel in the 1930s, when Denmark, Sweden and Norway followed the UK very quickly in leaving the gold standard in the time span between September and December 1931.

Third, the Nordic countries continued to trade with each other on pre-WW I levels. Trade levels did not decline, neither after WW I nor after the onset of the Great Depression. The share of Sweden’s export that went to the other two Scandinavian countries was 11 per cent in 1900 and remained at that level throughout the interwar period, for Norway the shares were stable at 6-7 per cent and for Denmark the share in 1900 was 18 and in 1930 12 %.11 Again, Finland is a special case. Before independence, Finland’s main trading partner was Russia (in 1880 48 per cent of all exports went to Russia, in 1900 it was 29 per cent). The Finnish-Russian trade situation was reversed completely after Finland’s independence in 1917, when Bolshevik Russia closed its border and its trade with the independent republic of Finland sank to almost nil (Kaukkiainen 2006, p. 148). However, in Finland rapid growth of western trade compensated for this and pre-war volumes of foreign trade were attained in 1923-14. In 1920, UK was the main trader (43 % of exports) followed by Sweden (8%). Between 1920 and 1930, Germany also rose as an important market for export (from 5% to 12 %).

11 Data calculated on basis of Mitchell.
5. Domestic forces versus international forces in the Nordic business cycle: the Swedish experience 1834-1913

The traditional view of the economic development of the Nordic countries has been described as “export-led” growth in which British demand for Nordic primary products and shipping services during the mid-19th century played a major role (for all in Jörberg 1973, Hodne 1981 and 1994). However, recently scholars have sought to modify the view, by for example pointing out the developments in the home market in the decades prior to 1850 as a key to the Nordic export-success and the mitigation of a ‘Dual Economy’ as has been observed elsewhere (Schön 1979, Ljungberg and Schön 2013).

5.1 Explaining the debate

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

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**

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
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<tbody>
<tr>
<td>#1</td>
<td>agricultural production</td>
</tr>
<tr>
<td>#2</td>
<td>communication</td>
</tr>
<tr>
<td>#3</td>
<td>industrial output</td>
</tr>
<tr>
<td>#4</td>
<td>mining</td>
</tr>
<tr>
<td>#5</td>
<td>construction</td>
</tr>
<tr>
<td>#6</td>
<td>transportation</td>
</tr>
<tr>
<td>#7</td>
<td>fixed investment</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Number of Time Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>1835-1939</td>
<td>14 time series</td>
</tr>
<tr>
<td></td>
<td>1854-1939</td>
<td>17 time series</td>
</tr>
<tr>
<td></td>
<td>1876-1939</td>
<td>26 time series</td>
</tr>
<tr>
<td>Finland</td>
<td>1834-1945</td>
<td>7 time series</td>
</tr>
<tr>
<td></td>
<td>1860-1945</td>
<td>14 time series</td>
</tr>
<tr>
<td></td>
<td>1868-1945</td>
<td>18 time series</td>
</tr>
<tr>
<td>Norway</td>
<td>1836-1950</td>
<td>15 time series</td>
</tr>
<tr>
<td></td>
<td>1851-1950</td>
<td>18 time series</td>
</tr>
<tr>
<td></td>
<td>1861-1950</td>
<td>20 time series</td>
</tr>
<tr>
<td>Sweden</td>
<td>1834-1950</td>
<td>16 time series</td>
</tr>
<tr>
<td></td>
<td>1864-1950</td>
<td>17 time series</td>
</tr>
<tr>
<td>England</td>
<td>1879-1913</td>
<td>17 time series</td>
</tr>
<tr>
<td>France</td>
<td>1879-1913</td>
<td>15 time series</td>
</tr>
<tr>
<td>Germany</td>
<td>1880-1913</td>
<td>17 time series</td>
</tr>
</tbody>
</table>
Table 4
Common dynamic factor analysis versus historical national accounts
Business cycle correlations of England, France, Germany, 1879 - 1913

<table>
<thead>
<tr>
<th></th>
<th>England (CDFA)</th>
<th>France (CDFA)</th>
<th>Germany (CDFA)</th>
<th>England (GDP)</th>
<th>France (GDP)</th>
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</thead>
<tbody>
<tr>
<td>France (CDFA)</td>
<td>0.78 ***</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Germany (CDFA)</td>
<td>0.81 ***</td>
<td>0.81 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>England (GDP)</td>
<td>0.84 ***</td>
<td>0.66 ***</td>
<td>0.72 ***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France (GDP)</td>
<td>0.28</td>
<td>0.55 ***</td>
<td>0.35 **</td>
<td>0.28 *</td>
<td></td>
</tr>
<tr>
<td>Germany (GDP)</td>
<td>0.22</td>
<td>0.15</td>
<td>0.36 **</td>
<td>0.02</td>
<td>0.48 ***</td>
</tr>
</tbody>
</table>

Sources: Own calculations based on GDP data from Maddison (2003).

Business cycle correlations of Nordic-4, England, France, Germany, 1870 – 1913

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>Finland</th>
<th>Norway</th>
<th>Sweden</th>
<th>England</th>
<th>France</th>
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<tbody>
<tr>
<td>Finland</td>
<td>0.26</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>0.29</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Norway</td>
<td>-0.05</td>
<td>0.07</td>
<td>0.11</td>
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<tr>
<td></td>
<td>0.02</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Sweden</td>
<td>0.16</td>
<td>0.50</td>
<td>0.31</td>
<td>0.18</td>
<td>0.47</td>
<td>0.22</td>
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<td></td>
<td>0.18</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>England</td>
<td>-0.05</td>
<td>0.25</td>
<td>0.14</td>
<td>0.06</td>
<td>0.34</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>-0.09</td>
<td>0.19</td>
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<tr>
<td>France</td>
<td>0.05</td>
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<td>0.09</td>
<td>0.07</td>
<td>0.25</td>
<td>-0.14</td>
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</tr>
<tr>
<td>Germany</td>
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<tr>
<td></td>
<td>0.22</td>
<td>0.29</td>
<td>0.20</td>
<td>0.30</td>
<td>-0.03</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Notes: The first entry in each cell refers is based on the cyclical component of a Hodrick Prescott trend cycle decomposition with $\lambda = 6.25$. The second entry refers to GDP growth rates.

Sources: Own calculations based on GDP data from Maddison (2003).
Table 5
Business cycle correlations 1834-1913 by country pairs:
Full period\(^1\), 1834-1870, 1870-1913

<table>
<thead>
<tr>
<th></th>
<th>De</th>
<th>Fi</th>
<th>No</th>
<th>Sw</th>
<th>England</th>
<th>France</th>
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</thead>
<tbody>
<tr>
<td>Finland</td>
<td>0.32</td>
<td>0.16</td>
<td>0.62</td>
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<tr>
<td>Norway</td>
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<td>0.64</td>
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<td>0.64</td>
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<tr>
<td></td>
<td>0.76</td>
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<td>0.70</td>
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<td>0.79</td>
<td>0.69</td>
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</tbody>
</table>

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 1834-1870 and 1870-1913, 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 1834-1913 (summary statistics)  
Full period, 1834-1870, 1870-1913

<table>
<thead>
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<th></th>
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<tbody>
<tr>
<td>Average r vis-à-vis</td>
<td></td>
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<tr>
<td>Nordic-4</td>
<td>0.56</td>
<td>0.36</td>
<td>0.54</td>
<td>0.62</td>
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<td>0.68</td>
<td>0.76</td>
<td>0.78</td>
<td>0.63</td>
<td>0.72</td>
<td>0.66</td>
</tr>
</tbody>
</table>

|                      |     |     |     |     |         |        |         |
| Average r vis-à-vis  |     |     |     |     |         |        |         |
| E, F, G              | 0.53| 0.71| 0.76| 0.67|         |        |         |

|                      |     |     |     |     |         |        |         |
| Average r vis-à-vis  |     |     |     |     |         |        |         |
| Nordic-3             | 0.68| 0.66| 0.70|     |         |        |         |
|                      | 0.67| 0.56| 0.59|     |         |        |         |
|                      | 0.73| 0.78| 0.82|     | 0.60    | 0.72   | 0.63    |

|                      |     |     |     |     |         |        |         |
| Average r vis-à-vis  |     |     |     |     |         |        |         |
| E, F, G              | 0.53| 0.76| 0.67|     |         |        |         |

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 1834-1870 and 1870-1913, respectively.
Table 7  
Business cycle correlations 1919-1939 by country pairs:

<table>
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<th>France</th>
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</thead>
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Notes: Entries are bilateral correlations of the cyclical component (as computed according to the description in the main text).

Sources: Cf. main text.
Table 8  
Business cycle correlations 1919-1939 (summary statistics)

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Summary statistics for Nordic-4 and England, France, Germany (21 bilateral correlations)

Average r vis-à-vis E, F, G = 0.54

Summary statistics for Nordic-3 (Denmark, Norway, Sweden)

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Summary statistics for Nordic-3 and England, France, Germany (15 bilateral correlations)

Average r vis-à-vis E, F, G = 0.53

Notes: Entries are bilateral correlations of the cyclical component (as computed according to the description in the 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 Denmark, Norway and Sweden, 1870 - 1913.

Source: Own calculations based on data as described in the main text.
Figure 3: Changing patterns of synchronization: Bilateral correlations during interval $[t-20, t+20]$ (40-year window).

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

Figure 4: Changing patterns of synchronization: Bilateral correlations during interval $[t-20, t+20]$ (40-year window).

Source: Own calculations based on data as described in the main text.
Figure 5: Business cycles of Denmark, Norway and Sweden, 1919 - 1939.

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

Denmark

1. Agriculture
   Year: 1820-1980 exports of grain / cattle
   Unit: 1000s tons
   Alternative # 1
   year: 1818-1975 ‘Agricultural product’
   source: Svend Aage Hansen, Nordic National Accounts database
   Unit: Current DNK
   File: Denmark data, ‘sectoraloutput’ B22:
   Comment: Data is very similar to the production values reported in Historical
           Statistics of Denmark for the same period (table 2.11, p. 152). Here also
           divided into vale of crop, milk products etc.) Hansen’s series have been
           criticized since they are poorly documented before 1895.
   Alt # 2
   year: 1875-1980 ‘Total crop yield, cereals and pulse’
   source: Danish Historical Statistics 1814-1980, (Hans Chr. Johansen, eds. H.P.
           table 2.8, p. 144.
           Unit: million feed units
           File: Denmark data, ‘sectoraloutput’ C79:
           Comment: after 1920 the series include Sönderjylland. 1920 is the overlapping
           year.
   Alt # 3
   year: 1875-1980 ‘Output of oats’
   source: Danish Historical Statistics 1814-1980, table 2.8, p. 147.
   Unit: 1000s tons
   File: Denmark data, ‘sectoraloutput’ D79:
   Comment: after 1920 the series include Sönderjylland. 1920 is the overlapping
   year.

2. Communication
   Year: 1853-1989 ‘mail’
   Year: 1861-1989 ‘telegrams’
   Source: Mitchell, p.833

3. Industrial output
   year: 1818-1975 ‘Production of milk and milk products’
   Unit: Current DNK, part of national accounts
   Comment: This is (more or less) a subset of the agricultural series reported in
           Hansen. It is debated among Danish economic historians if milk and milk
           products could be regarded as industrial output.
   Alt #1
   year: 1820-1874 ‘exports of butter’
   Unit: tons
Alt #2
Year: 1891-1961 ‘production of beer’
Source: Mitchell, p. 603

4. Mining
year: 1818-1975 ‘Brown Coal Production’
source: Svend Aage Hansen, Nordic National Accounts database
Unit: current DNK
Alt # 1
year: 1940-1973 ‘Output of coal’
source: Mitchell, p. 467
unit: millions of metric tonnes

5. Construction
year: 1876-1917 ‘New Flats in Copenhagen’
Unit: number
year: 1917-1928 ‘New Flats in Copenhagen and provincial towns’
Unit: number
year: 1928-80 ‘New Flats in Denmark’
Unit: number

6. Transportation
Year: 1814-1980 Total tonnage of registered merchant ships
Unit: 1000 tons

7. Fixed Investment
Year: 1844-1980 ‘Gross capital formation’
Alt # 2
Year: 1847-1956 ‘Length of railway network’
Unit: kilometres

8. Government expenditure
Year: 1820-1880 ‘Expenditure of Finansdeputationen’
Unit: 1000 current rigsdaler
Year: 1854-1949 ‘Total Central Government Expenditure’
Source: Mitchell p. 912
Unit: Thousands of millions DKK

9. Government revenue
Year: 1820-1850 ‘Revenues from Denmark’
Unit: 1000 current rigsdaler
Year: 1854-1949 ‘Total Revenue’
Source: Mitchell p. 927
Unit: Thousands of millions DKK
Year: 1855-1914 ‘Total Revenue’
Source: Hansen 1974, table 13, p. 270
Unit: millions DKK
Comment: roughly similar to data in Mitchell, but not completely.
10. Narrow money  
Year: 1819-1960 ‘note stock’  
Unit: Millions of DKK  
11. Broad money M2  
Year: 1875-2006 ‘broad money’  
Source: Abildgren (2006: 79-80)  
Unit: Millions DKK  
12. CPI  
1800-2000 ‘CPI’  
Unit: index, year 2000 = 100.  
13. Domestic interest  
1814-1980 ‘Discount rate of the central bank’  
1814-1980 ‘effective yield of government bonds’  
1875-2006 ‘Central bank discount rate’  
Source: Abildgren (2005a:14-15; 2010: Data for Essay 2, Table 2.B.1 spreadsheet)  
14. Mortgage credit  
Year: 1835-1960 mortgage loans and loans against other forms of security’  
Unit: current million DKK  
15. Terms of trade  
Year: 1815-1980 Foreign trade prices and terms of trade  
16. Real exchange rate  
17. Export  
year: 1818-1910 Total exports  
Unit: million current DNK  
imported in Mitchell, p. 619.  
18. Import  
year: 1841-1910 Total imports  
source: Danish Historical Statistics 1814-1980, table 4.2, p. 194  
Unit: million current DNK  
imported in Mitchell, p. 619.  
19. Trade balance
20. External spread
21. Foreign capital inflows
Balance of Payments provided 1874-1980. P. 221 in Historical Statistics

22. Wage
Year: 1818-1870 ‘Farm wages’
Unit: Index, 1870=100
year: 1870-1980 ‘wages in the crafts and industries’
source: Danish Historical Statistics 1814-1980, table 7.5, p. 294
unit: öre per hour
Alt # 2
Year: 1875-2006 ‘Nominal wages, total paid in economy’
Unit: Millions DKK
Source: Abildgren (2008: 40-41)

25. Population
1820-2007
Source: Maddison’s database.
Unit: 1000s.
Finland

1. **Agriculture**
   year: 1856-1970 ‘harvests of rye’
   source: The Economic History of Finland, 1983. p. 81, table 2.9
   unit: tonnes

2. **Communication**
   year: 1870-1975 ‘telegrams’
   source: Mitchell p. 833
   unit: thousands
   Alt # 2
   year: 1870-1975 ‘mail’
   source: Mitchell p. 833
   unit: millions

3. **Industrial output**
   Year: 1845-1870 ‘quantities of beer and porter’
   source: Bidrag till Kännedom av Finlands Natur och Folk, Hantverk och fabriker III, Per Schybertsson, Helsinki 1974. p. 78 table 8
   year: 1809-1859 ‘exports of firewood’
   source: The Economic History of Finland, 1983. p. 172, table 5.4
   unit: cords
   year: 1860-1950 ‘exports of wood’
   source: Mitchell
   unit: thousands of metric tonnes
   Year: 1884-1954 ‘employees in industry according to industrial statistics’
   Source: The Economic History of Finland, 1983. p. 119-20 table 4.3

4. **Mining**
   year: 1808-1859, ‘exports of pig iron’
   source: The Economic History of Finland, 1983. p. 174 table 5.4
   unit: ship pounds
   year: 1860-1919, ‘exports of pig iron’
   source: The Economic History of Finland, 1983. p. 174 table 5.4
   unit: tons

5. **Construction**
   year: 1860-2009 ‘Volume index of building construction’
   source: Hjerpe, FHNA
   unit: index 1926=100
   year: 1834-1892 ‘general fire indemnity association of municipalities’
   source: Economic history of Finland, p. 346
   Unit: 1000 000 FMK
   Year: 1893-1950 ‘total stock of fire insurances’
   source: Economic history of Finland, p. 348
   Unit: 1000 FMK

6. **Transportation**
   year: 1862-1950, can be extended to 2004 ‘passenger kilometres on railways’
   source: Mitchell, p. 765
   Year: 1862-1972 ‘freight cars on state railways’
   Source: Economic history of Finland, p. 275, table 7.2.
   Unit: no of cars
7. **Fixed Investment**  
Year: 1862-1950 ‘total length of railway tracks and lines’  
source: Economic history of Finland, p. 272, table 7.1  
Unit: km

8. **Government expenditure**  
year: 1882-1950  
source: Mitchell, p. 912

9. **Government revenue**  
year: 1810-1900 ‘Revenue from direct taxes’  
source: Economic history of Finland, p. 356-57  
Unit: 1000 silver rubles  
year: 1882-1950 ‘central government revenues and main tax yields, total’  
source: Mitchell, p. 927  
Unit: 1000000 FMK

10. **Narrow money**  
year: 1813-1990, ‘Coins and notes’  
source: CB coins and notes (Finland): Mitchell (2007), International Historical  
Tilastokeskus - Statistikcentralen - Statistics Finland  
Comment: The monetary unit before 1860 was Russian rouble. That has been  
converted to Markka

11. **Broad money M2**  
year: 1868-1951, can be extended to 1980.  
Pankin keskustelualoitteita 3 1/96 (Bank of Finland Working Paper)

12. **CPI**  
year: 1860-2009 ‘cost-of-living index’  
source: Hjerpe, FHNA  
Unit: index 1926=100

13. **Domestic interest**  
year: 1862-1952 ‘Bank of Finland discount rate’  
source: Jaakko Autio: Korot Suomessa (Interest Rates in Finland, 1862-1952),  
Bank of Finland discussion papers 7/96.  
Alt # 1  
year: 1862-1952 ‘Commercial Bank rate’  
source: Jaakko Autio: Korot Suomessa (Interest Rates in Finland, 1862-1952),  
Bank of Finland discussion papers 7/96.  
Unit: %

14. **Mortgage credit**  
year: 1860-1900 ‘Domestic deposits in commercial banks’  
source: Economic history of Finland p. 328, table 8.2  
Unit: 1000 Finnish Markkas

15. **Terms of trade**

16. **Real exchange rate**

17. **Export**  
year: 1813-1961 (can be extended to 2004) ‘external trade’  
source: Mitchell, p. 619
18. **Import**
year: 1813-1861 (can be extended to 2004) ‘external trade’
source: Mitchell, p. 619

19. **Trade balance**

20. **External spread**

21. **Foreign capital inflows**

22. **wage**
year: 1813-1893 ‘Daily wages of carpenters employed by the town of Helsinki, summer season
unit: FMK (finnish mark, current prices)

Year: 1850-1913 ‘daily wages of male agricultural workers’
unit: index (1913=100)

year: 1860-2009 ‘Nominal wage index in manufacturing’
source: Hjerppe, Finnish National Accounts
unit: index (1926=100)

25. **Population**
year: 1800-1860
source: Mitchell
unit: Millions

year: 1860-2009
source: Hjerppe, FNHA
unit: Thousands
Sweden

1. Agriculture
1800-1950: ‘Total grain yield’
Unit: 1000 tonnes
Source: From Historical Statistics for Sweden, part 1, table E16, p. 46.
Unfortunately the series only report 5 year averages 1820-60. Supplemented
with agricultural output per fam in Scania from Olsson and Svensson EREH
2010, 14: 275-304.

2. Communication
1853-1950: ‘telegrams’, ‘letters’
Unit: number of telegrams / letters
Source: Bidrag till Statens Officiella Statistik, BISOS, Historisk
Statistik för Sverige, p. 84 table. 54

3. Industrial output
1800-1950: ‘output of manufacturing iron
Unit: tons
Source: Output of pig iron 1800-1871, tons
from table 2 in Schön 1988: Historiska Nationalräkenskaper för Sverige:
steel and iron 1860-1958, tons / Data from 1860 to 1958 can be found in
Historist Statistik för Sverige, Del 3 Utrikeshandel, tables 3.2 (p. 205), 3.4 (p.
215) and 3.6 (p. 228).
Alternative # 2
Year: 1875- ‘brännvinstillverkning’ / alcoholproduction
Unit: “bottles”
Comment: This kind of data is reported in the statistical yearbooks frm 1875,
but not earlier.

4. Mining
1800-1835: Schön 1988: Historiska Nationalräkenskaper för Sverige: Industri
och Hantverk 1800-1980, , table 2
Unit: Measured in Kilograms
1836-1950: Mitchell, output of iron ore
Unit: millions of metric tons

5. Construction
1814-1900: ‘Stockholm’s inflow of bricks, domestic and foreign’
Unit: 1 000 000s
Source: Bruno, William (1954) Tegelindustrien in Mälarprovinserna 1815-
1950, Med särskild hänsyn till Stockholm som marknad. Akademisk
avhandling Uppsala. Fig 5.
1900-1950: ‘Houses built in Stockholm and Mälarprovinces’
Unit: 1000s
Source: Bruno, William (1954) Tegelindustrien in Mälarprovinserna 1815-
1950, Med särskild hänsyn till Stockholm som marknad. Akademisk
avhandling Uppsala. Fig 9, p. 105.

6. Transportation
1800-1900: Data on number of horses and oxen used in vehicle transportation
(Anspannsfordon: Bruttoproduktion)
7. Fixed Investment
1828-19: ‘total sum of fire insurances’
Unit: 1000s SEK, current prices
Source: Source: Bergander 1967, p 132-133

8. Government expenditure
Expenditure of „Government Proper“ (Excluding Special funds)
Fregert & Gustafsson (2008), „Fiscal statistics for Sweden 1719-2003“ Research
Unit: thousand SEK

9. Government revenue
Revenue of „Government Proper“ (Excluding Special funds)
169-224, Tables A:15, A:17, A18.
Unit: thousand SEK

10. Narrow money
1800-1869: Mitchell 2007, Central banks coins and notes
1870-2000: Edvinsson (2010), M0 (according to Statistics Sweden’s (SCB)
definition. Outstanding coins and notes from banking system. Private bank notes are included until 1903)
Unit: million SEK

11. Broad money
1800-2000: Edvinsson (2010), M3 (according to Statistics Sweden’s (SCB)
definition)
Unit: million SEK

12. CPI
1800-2000: Edvinsson et al. (2010), CPI
Unit: 1914 = 100

13. Domestic interest
interest rate” (accessed through http://www.riksbank.se/en/The-
Riksbank/Research/Historical-Monetary-Statistics/Interest-
and-stock-returns/)
Unit: per cent

14. Terms of trade
15. Real exchange rate
16. Export
1800-2000: SHNA, “exports”
Unit: million SEK
Alt # 1
1830-1950: SHNA, “exports”
Unit: million SEK
Source: Mitchell, p. 628, table E1
17. Import
1800-2000: SHNA, “exports”
Unit: million SEK
Alt # 1
1830-1950: SHNA, “imports”
Unit: million SEK
Source: Mitchell, p. 628, table E1
18. Trade balance
19. External spread
Unit: per cent
20. Foreign capital inflows
Unit: Million SEK
24. wage
1803-2000: Larsson (2010) in Edvinsson et al., nominal wage of male
agricultural workers / unskilled labour
Unit: Index, 1960 = 100
25. Population
Unit: number of people
Norway

1. Agriculture
   year: 1835-1950 (can be extended to 1993), ‘fish exports’.
   source: Mitchell, table C11, p. 451
   Unit: Thousands of metric tons

2. Communication
   year: 1855-1952: (series can be extended to 1992). ‘telegrams’
   source: Mitchell, table F8, p. 840
   Unit: 1000s

3. Industrial output
   year: 1836-1950, (can be extended to 1993), ‘timber exports’
   source: Mitchell table C11, 451
   Unit: Million cubic until 1931, thousand cubic thereafter

4. Mining
   year: 1861-1950, ‘output of iron ore’
   Source: Historisk Statistik 1968, Norges Offficielle Statistik XII, 245,
   Unit: Tons

5. Construction
   Year: 1900-1968 ‘private construction /contractors, building construction’
   Source: Historical statistics of Norway (1968), table 150 p. 242
   Unit: Manhours

6. Transportation
   1850-1950: ‘merchant ships registered’
   Source: Mitchell p. 785
   Unit: total ton (sail + steam)

7. Fixed Investment
   1836-1965 ‘sales of real property’
   Source: Historical statistics of Norway (1968), table 99 p. 149
   Unit: total number of property
   Year: 1854-1959 ‘length of railway line open’
   Source: Mitchell, p. 738, table F1
   Unit: kilometres

8. Government expenditure
   1830-1866: ‘Total Government consumption’
   Source: Bjørsvik, Elisabeth 2004 “Offentlige tjenester i Norge 1830-1865
   innenfor rammen av historiske nasjonalregnskaper” = Public services in
   Norway 1830-1865 within the framework of historical national accounts,
   Doctoral Dissertation, Norges Handelshøyskole. Institutt for
   samfunnsøkonomi
   1850-1950: ‘Total Central Government Expenditure’
   Source: Mitchell p. 918
   Unit: Thousands millions NOK, current prices

9. Government revenue
   1850-1950: ‘Total Central Government revenue and main tax yields
   Source: Mitchell p. 948
   Unit: Thousands millions NOK, current prices

10. Narrow money
1819-2010: ‘MO monetary base excl. Treasury deposits’
Unit: Million NOK, current prices
File: Norway data, ‘financial’ C23:C214

11. Broad money M2
1819-2010: ‘M2’
Unit: Million NOK, current prices
File: Norway data, ‘financial’ C23:C214

12. CPI
1800-2000: CPI
Unit: Index 1998=100

13. Domestic interest
1819-2011: ‘Marginal liquidity rate’
Unit: annual average, nominal

14. Mortgage credit
1822-2010: ‘Total lending’

15. Terms of trade

16. Real exchange rate

17. Export
1830-2010: ‘export’, part of national accounts
Unit: Million NOK, current prices

18. Import
1830-2010: ‘export’, part of national accounts
Unit: Million NOK, current prices
Alternatives to exports and imports as parts of the national accounts are the data produced in Mitchell.

**19. Trade balance**

**20. External spread**

1822-2012: Average bond yield


Unit: Nominal annual average

**21. Foreign capital inflows**

**22. wage**

1820-1940: ‘Daily wages for male workers in agriculture’


Unit: NOK, current

1938-1970: ‘summer wages in agriculture and forestry’,

Source: Mitchell p. 208.

Unit: index, 1950=100

**25. Population**

1800-1830: ‘Mid-year population’


1830-2010: ‘Mid-year population’


Unit: persons
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.

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Bibliography


