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BUSINESS CYCLE, CURRENCY AND TRADE, REVISITED

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Toshihiro Okubo**

Abstract

This paper reports estimates based on long-run data sets for GDP and trade, with three sub-samples chosen to reflect the first globalization period, the "bloc economy" period and the second globalization period. The business cycle is identified as the series of deviates from a Hodrick-Prescott filtered trend, and turning points are identified. Cross-correlations of the cyclical deviates are calculated for all the pairs of the 21 countries examined. It is apparent from casual inspection that the business cycle characteristics and the pattern of cross-correlations in the bloc economy period are different from those found for the two globalization periods whilst there is less difference between the two globalization periods. Estimation is undertaken of equations to explain the pattern of cross correlations in terms of trade and currency union membership. A dummy for the countries that belong to the Eurozone is found to be significant for the period of the first globalization, that is, well before any manifestation of a common Euro-currency is available. By contrast, Asian business cycle co-movement cannot be found.

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JEL:E3;F4;F5;N1

Keywords: business cycle; currency union; trade; globalization; Eurozone, Asian business cycle

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1. INTRODUCTION

This paper re-examines the links between business cycle synchronization, trade and currency, doing so in a long run context. Studies of these links are not new, but our paper capitalizes on some novel features which have not been exploited before. Existing studies have mostly employed data for the period from 1960, while some concentrate on the very recent period since 1990. A notable exception to this is Flandreau and Maurel (2005) who study the impact of trade and currency unions on business cycle synchronization in the 19th Century and up to the end of the classical gold standard.[1] In our paper we take advantage of the availability of long-run GDP and bilateral trade data for the whole period from 1870 to 2004. Conditioning on globalization we divide the sample into three subsamples corresponding to the first globalization, commonly associated with period from 1870 to 1914, the period of the bloc economy running from 1915 to 1959; and the period of the second globalization running from 1960 to the end of our sample. In Artis and Okubo (2009) we have already drawn attention to the importance of conditioning on globalization when examining the transmission (or synchronization) of business cycles. Here we add to that discussion by locating cyclical turning points in the business cycles of our sample of 21 major countries, which enables us to comment further on the characteristics of business cycles in the three periods. Our long run GDP data comes from Maddison (2003). Complementing that series we are now able to draw upon a long run of trade data produced as part of the COW project (see Barbieri, Keshk and Pollins, 2008). This enables us to revisit the central issue of the relationship between trade and the synchronization of business cycles between countries. The issue originally stems from early discussion of the empirical implementation of optimal currency area criteria (Mundell, 1961; McKinnon, 1964; Kenen, 1969). The earlier literature established a presumption that the relationship between trade and business cycles could depend on the currency regime in force between the countries involved.[2] It also established that there are difficult issues of endogeneity and reverse causality involved which call for (and may stretch the limits of) appropriate estimation. In the earlier wave of studies on this point (e.g. Rose, 2000; Frankel and Rose, 1998; Engel and Rose, 2002) a good deal of effort was put into specifying dummy

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[1] Artis and Okubo (2011) study the impact of trade intensity and trade and currency blocs on business cycle synchronization in the long-run panel data in the late 19th and early 20th centuries. By contrast, this paper focuses on currency unions and trade intensity in the framework of Frankel and Rose (1998). Turning from business cycle to international trade, Eichengreen and Irwin (1995) and Okubo (2008) study the impact of trade and currency blocs on trade flows in the inter-war period in the gravity equation framework.

[2] Many previous studies find that currency regime significantly affects trade flow. See Rose and Stanley (2005), Baldwin (2006) and Rose (2000).

variables to condition the estimates upon, e.g., common language, contiguity and so forth. In this paper we confine ourselves to currency union dummies and investigate the causality issue ~~the~~ further by a dedicated examination of the impact of a EURO dummy for the countries partaking in the Eurozone even before the project to realize a Eurozone was conceived.[3] The importance of this dummy in the period of the first globalization suggests that the Eurozone is innately an optimal currency area. Similarly, we investigate Asian business cycle co-movement to investigate whether Asia is potentially satisfactory to the optimal currency area criteria.

As a result of estimations we have several findings. First, the first and the second globalization periods see business cycle synchronization, while the bloc economy sees idiosyncratic business cycles. The business cycle in the second globalization is more synchronized than in the first one. Second, trade and currency union could promote business cycle synchronization. In the second globalization, trade significantly affects business cycle correlations, while currency blocs largely impact synchronization in the bloc economy. Third, long before the advent of the Euro itself, the Eurozone exhibits highly correlated business cycles. Finally, we cannot observe any Asian business cycle synchronization in any time period~~s~~.

In what follows we first discuss business cycle identification and examine the ways in which the stylised business cycle facts change between the subsamples. We then highlight the cross correlations between the business cycles of each pair of countries as a surrogate for synchronization and convergence. In Section 3 we turn to the issue of explaining these cross correlations in terms of currency union participation. In Section 4 we broach the issue of Asian business cycle~~s~~ co-movement in historical data. At the end of the paper we adduce some conclusions from the analysis.

2. IDENTIFYING BUSINESS CYCLES

2.1. *Business Cycles*

The type of cycle on which we focus is the deviation or growth cycle, where the underlying idea is that the business cycle can be identified as a cycle relative to a trend. Thus some kind of filter is required to provide a measure of the trend, and the cycle is identified as the

[3] Bayoumi and Eichengreen (1997) propose an OCA index and apply it to European countries to test whether European countries form an OCA.

deviation from this trend. In our case, where the original data are annual, there is a reasonable presumption that high-frequency noise (seasonal and the like) is already filtered out by the aggregation of the data to annual frequency. On this basis we use a Hodrick-Prescott (HP) filter with a lambda value (dampening factor) set at 6.25, following the suggestion of Ravn and Uhlig (2002): this corresponds to a maximum periodicity of the cycle of 10 years, just as the popular lambda value of 1600 does for data at a quarterly frequency (see Maravall and Rio, 2001). There remains a degree of controversy about the procedure, as exemplified most recently in the paper by Meyers and Winker (2005), following earlier papers by Harvey and Jaeger (1993), Burnside (1998) and Canova (1998) among others. However, an effective counter-criticism can be found in Kaiser and Maravall (2001, 2002) and we are encouraged to believe that the procedure we have adopted is not seriously flawed. The filter has been applied to the log of the GDP series for each country and the residual from it is identified as the cyclical deviate, the series which form the focus of our analysis.

Figure 1 shows the HP-filtered GDP cycles constructed in this way for the three sub-sample periods in some representative countries, i.e. France, Germany, the United Kingdom, the United States and Japan. In the inter-war bloc economy period, all countries experienced large fluctuations, in particular Germany and Japan before and after World War II, although the 1950s are quite stable and convergent among countries. The period of the second wave of globalization appears to have much more synchronised cycles than the other two periods.

Then, using the HP-filtered GDP for each country in each sub-sample period, we take bilateral cross-correlations of the cyclical deviates for each pair of countries. The resultant cross-correlograms are shown in Tables 1-3. Figure 2 shows the results in the form of histograms registering the frequencies of the bilateral cross-correlations. They facilitate comparisons among the three periods from which we see some interesting results. First, the average of the cross-correlations is highest in the second globalization period (around 0.4 compared to around zero to 0.2 in the first globalization period). Second, the variance is the largest in the bloc economy period. In that period, the average of cross-correlations is around 0 to 0.3 but the distribution has two humps. Many pairs have negative correlations whilst on the other hand some pairs support quite high positive correlations, even around 0.7 to 0.8. This is consistent with the idea that some allied bloc-members are positively correlated, while

countries without alliances are negatively correlated. The two-hump shape of the histogram can be viewed as reflecting how closed and exclusive the bloc economy was.[4]

Table 4 shows the stylized facts of each country's business cycle for each period. The data it contains are derived from the identification of turning points in the cyclical series. This identification is achieved by using a suitably modified version of the Bry-Boschan algorithm. Whilst it is comparatively uncommon to date the turning points in annual series because of the perception that the aggregation to an annual frequency risks smearing the identification of the true (say, monthly) turning points across pairs of years, in our case we are less interested in precise dating than we are in the relative characteristics of the cycles in the different sub-samples. These characteristics can only be revealed after a dating of the peaks and troughs has been undertaken.

The number of cycles identified for individual countries appears considerably larger, at over 10 on average, for the bloc economy period than for the other two periods, though the second globalization period hosts more cycles (around 8 to 9 across the individual countries) than the first globalization period. The duration of the expansion phase of the cycle appears clearly longer – at around 4 years – in the bloc economy period than in the other two periods, with recessions somewhat shorter, at less than 2 years on average compared to 2 or a little more in the other two periods. The expansion and recession probabilities shown are obtained as the proportion of the total time spent in expansion or recession; consistently with what we have just noted about the relatively greater length of the expansion phase in the bloc economy period, the expansion probability for that period is clearly larger than the probability of recession, whereas for the other two periods the probabilities appear about equal. Finally, the measurement of the amplitude of the cycles reveals that the cycles were deeper in the bloc economy period than in the other two periods and that the average amplitude was least in the second globalization period (coinciding in part with the period of the "Great Moderation"). Thus the business cycle characteristics, as well as the pattern of cross-correlations between them, appear markedly different for the bloc economy period than for the two globalization periods.

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[4] Appendix Table A shows cross-correlations in the inter-war period from 1914 to 1945. This is aimed at highlighting the bloc economy with its many alliances. The results are almost the same as those quoted for the bloc economy period of 1915-1959.

2.2. *Non-parametric Analysis*

The bloc economy period is largely different from the other two periods in cross-correlations of business cycles. However, between the two globalization periods themselves the pattern of cross-correlations also differs. Thus it demands some statistical verification. To this end we employed three different non-parametric tests: the Wilcoxon signed rank test, the Mann-Whitney test and the Kolmogorov-Smirnov test.

Wilcoxon signed rank test

First, we employ the Wilcoxon signed rank test to assess whether the cross-correlations of country pairs changed from the first to the second globalization period. Here we treat the data as matched. We focus on the rise or fall in the cross-correlation in each country pair from the first to the second globalization period. As a result, we can significantly reject the null hypothesis that the cross-correlation in each country pair between two periods is the same (z-value= -8.357, p-value=0.00). This indicates that the cross-correlations are higher in the second globalization period and hence are not identical.

Mann-Whitney test

Second, we use the Mann-Whitney test (Mann and Whitney, 1947) to confirm that the distributions are different. We assume two independent samples, i.e. unmatched data between the first and the second globalizations. Then we use the Mann-Whitney two-sample statistic to test whether the two distributions of cross-correlations are the same. The null hypothesis that the distribution is the same in the two globalization periods is significantly rejected (z-value= -8.484, p-value=0.00).

Kolmogorov-Smirnov test

Further confirmation was sought from an application of the Kolmogorov-Smirnov test. The hypothesis is that the set of cross-correlations in the first globalization contains smaller values than those in the second globalization. The largest difference between the distributions is 0.3952. The p-value for this is 0.000. This is significant. We can say that the two distributions of cross-correlations are significantly different and that the second globalization period saw a higher average of cross-correlations. This finding complements the evidence set out in, for example, Bordo et al (1998), Baldwin and Martin (1999) and Kose et al (2003).

We are now in a position to examine the relationships between the cyclical cross-correlations, trade and currency. There is an extensive literature on this issue, largely instigated by Frankel and Rose (1998), and aimed initially to the issue of whether or not the advent of the Eurozone could be expected to be associated with an increase in trade. Following Krugman's (1993) picture of the decision to join a currency union as involving a trade-off between the benefit of increased trade and the cost of losing monetary independence, it was noted that if joining a currency union in itself increased trade, then the traditional optimal currency criteria set out and developed by, for example, Mundell (1961), McKinnon(1963) and Kenen (1969) might turn out to be endogenous. Frankel and Rose (1998) exploited this insight, which led to a large number of subsequent studies in a similar vein (e.g. Gruben et al (2002) and most recently Imbs (2004) and Inklaar et al (2008)). The relationship between currency union and trade then formed the basis for estimates in which the object of attention was the trade-raising effect of currency union (e.g. Rose, 2000). This proved to be extremely controversial; it became obvious that the relationship between trade, the cycle and currency union was one fraught with problems of reverse causation – not that the initiators of this line of estimation were unaware of these hazards. In this paper we can add a little to that debate.

3. ESTIMATIONS

3.1. *Trade Intensity and Currency Union*

We use trade intensity to measure how tightly two countries are linked with each other through international trade. Our trade intensity is measured by export intensity, defined as

$$Trade_{ij} \equiv \frac{X_{ij} / X_i}{M_j /(M^W - M_i)}$$

where X_i denotes total exports from country *i* and M_j denotes total imports into country *j*.[5] X_{ij} is trade from country *i* to *j*. M^W is total imports in the world. The higher the values of these indices the more closely are the two countries *i* and j linked by international trade.

Turning to currency, we use a currency dummy to capture the effect of participation in a common currency union. If the two countries use common currency or two currency regimes are tightly linked, as for example some were in the 1930s world-wide currency blocs, then

[5] Even if we replace export intensity with import intensity as trade intensity, all main results can be kept.

dummies take unity and otherwise zero. To highlight the impact of a common currency, we focus on major currency unions among 21 countries, i.e. Scandinavian currency union, Latin currency union in the first globalization era, gold bloc, Sterling area, Reichsmark bloc, US dollar area in the bloc economy era, and the Euro zone in the second globalization era. (See Data Appendix for detail on the country components.)

3.2. *Business Cycle, Trade and Currency*

Following Frankel and Rose (1998) and Engel and Rose (2002), we estimate the impact of trade and currency unions on business cycle synchronization from a gravity model-type specification, which indicates that larger and similar GDP countries and active bilateral trade promote business cycle synchronization:

$$(1)\ Corr_{ij} = c + \alpha(Trade_{ij}) + \beta(GDP_{ij}) + \gamma(CU_{ij}) + \sum \eta_k D_k + \varepsilon_{ij}$$

where *Corr* is the cross-correlations of HP filtered GDPs between countries *i* and *j*. *GDP* denotes the logarithm of the product of GDPs in countries *i* and *j*. *Trade* denotes export intensity between two countries. We note that both the *GDP* and *Trade* variables are expressed as averages of each year's value in each period. *CU* denotes the dummy of currency unions or common currency. If two countries *i* and *j* share the common currency at least once during the period, the dummy is unity and otherwise zero. *D* denotes country dummies.

We estimate (1) by generalized least squares (GLS) regression. Table 5 reports the results. Our primary interest is in α and γ. α is significantly positive in the first and second globalization periods. More trade raises business cycle synchronization. As seen in the bottom panel, α in the second globalization is significantly positive. However, the α coefficients are not significant at all and close to zero in the bloc economy (middle panel). Furthermore, the currency blocs, rather than trade intensity, definitely affect business cycle synchronization in the bloc economy. Some inter-war currency blocs such as the gold bloc and dollar area are significantly positive. All the coefficients are large and much larger than those of trade intensities. In the second globalization era, the Eurozone dummy is significantly positive, though the values of coefficients are generally smaller than those obtained for the bloc economy period.

3.3. *Causality and EURO Zone*

Although our estimation results are reasonable, we need to be careful about qualifications in our regression results. An important issue is that of causality in relation to the currency union dummy. According to the standard theory of optimal currency areas, high cross-correlations and a high degree of trade intensity are both positive indications of a suitable environment for the formation of a currency union. From this point of view a positive sign on the currency union dummy reflects the presence of these prior conditions. On the other hand it may be that by joining a currency union, countries' business cycles come to be synchronized. To investigate this issue, we single out the EURO area. As seen in Table 6, the coefficient on the dummy for the EURO zone indicates a significant positive effect on business cycle synchronization in the first globalization era. The coefficient is 0.09, which is less than 0.21 (Table 5) but somewhat closer to that found for the period of the second globalization. By contrast, during the bloc economy period (which includes observations from the two World Wars), the Euro zone economies were largely pitted against each other and the EURO dummy in this period is neither significant nor positive. These findings seem to demonstrate that, aside from the political distortions wrought by war, the fact is that the economies of the Euro zone have highly synchronized business cycles regardless of the physical presence of the Euro – in this sense it might be said that the Eurozone was always a good candidate for the appellation optimal currency area.

4. ASIAN BUSINESS CYCLES

While the last section studied the impact of currency unions and blocs in Europe, this section turns to Asian business cycles. The Asia and Pacific area has not experienced its own common currency in its long history, despite some Asian countries experiencing European colonization and being involved in European currency blocs in the inter-war period. However, an investigation into the synchronization is fairly worthwhile when thinking of the future Asian monetary and currency system and future economic integration in Asia. As seen in the last section, the Eurozone was *innately* an optimal currency area in the first globalization period. Likewise, a similar idea is applicable to Asia to study the potential of an Asian optimal currency area. Specifically the questions arise as to whether Asian business cycle co-movements already existed in the late 19th century or early 20th century and whether Asia has seen any regional business cycle synchronization and is innately an optimal currency area

regardless of no explicit currency union, common currency and common monetary policies. Similar to the last section, we regress the following equation:

$$(2)\ Corr_{ij} = c + \alpha(Trade_{ij}) + \beta(GDP_{ij}) + \gamma(CU_{ij}) + \delta(Asia) + \sum \eta_k D_k + \varepsilon_{ij}$$

where *Asia* denotes Asian dummies. If two countries are Asian in our definition below, the dummy takes unity and otherwise zero. Due to no explicit intra-Asia currency union and common currency, there are no indisputable definitions on Asia (and Pacific area). Thus there are a variety of possible definitions on Asia. In this paper, regardless of a limited number of countries in our historical GDP and trade data, we first of all use a basic definition as East Asia (Japan and China) and Oceania (Australia and New Zealand) in our sample countries (this Asian dummy is called "Asia 1"). The second dummy involves a historical viewpoint. In the period before World War II, many Asian regions were colonized by European countries. Since their colonies in Asia might be linked with European countries and large Asian countries, business cycles might be correlated among them via Asian colonies. In this historical viewpoint Asia might be defined as the above-defined Asia plus the United Kingdom, the Netherlands and France in our sample, all of which had colonies in Asia and resort to dominant colonial power (this Asian dummy is called "Asia 2"). This dummy is adopted for the estimation in the period of the bloc economy. The last possible definition is based on the current decades of the world. Currently Asian countries have been tightly linked with many other Pacific countries in economic and political relationship (e.g. APEC). Thus, the Asian-Pacific region is defined as Australia, New Zealand, Japan, and China plus Canada and the United States (this Asian dummy is called "Asia 3"). This dummy is adopted for the estimation in the second globalization period.

Table 7 reports the results. All of the Asian dummies (Asia 1 to Asia 3) are not significantly positive ~~at all~~. Thus we can say that there are no Asian co-movements in business cycles. This is plausible. Asian countries have no large labor migration and are politically segmented. In terms of trade, (horizontal) intra-industry trade is less likely to be seen. In the past trade was dominated by colonial trade with Europe, which is mainly inter-industry trade. Even today, foreign direct investment promotes vertical intra-industry trade and intermediate input trade. For these reasons, Asian business cycles have not been historically synchronized.

5. CONCLUSIONS

This paper has extended previous work on the relationship between trade, the business cycle and currency areas to the long run, involving 21 major countries. The whole sample is broken into three sub-samples corresponding, respectively, to the first globalization era, the period of the bloc economy and the second globalization era. That there are significant differences between the three periods is strongly demonstrated in the course of the paper; equally, the similarities between the first and second globalization periods, in terms of key business cycle characteristics and the coefficients estimated in our key equations are striking, with differences that are by contrast with the corresponding features of our bloc economy period, quite small if sometimes significant.

The estimation confirms the positive association of trade with business cycle convergence and of the latter with currency area membership, only with some qualifications and exceptions; notably, in the interwar period currency area membership seems more important than trade in fostering business cycle convergence. Earlier literature has made it well-known that there are substantial issues of reverse causation involved in the relationship between trade, business cycle convergence and currency union. The present study has uncovered a striking example of the issue; when the dummy for the Eurozone is inserted into the equation estimated for the first globalization period (1870-1914) and thus long before the advent of the Euro itself, it attracted roughly similar valued coefficient as in the second globalization period.

On the other hand, although Asia has not yet experienced monetary integration, the dummies for Asia and Pacific regions, when inserted into the estimation, are not significant at all. Asian business cycle synchronization cannot be observed in any time period. This indicates that if Asia aggressively takes on a common currency and monetary system, or Asia takes the first step towards economic integration, it is essential first to make enough effort on the convergence of the idiosyncratic business cycle.

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DATA APPENDIX

Data Source and Definitions

Real GDP data

The data are taken from Maddison (2003) “The World Economy: Historical Statistics”. The unit is million 1990 international Geary-Khamis dollars. The GDP data for Russia and China are taken from “Macroeconomic Crises since 1870” by Robert J. Barro and Jose F. Ursua. http://www.economics.harvard.edu/faculty/barro/files/MacroCrisesSince1870_08_0614.xls

Trade data

Bilateral trade data are taken from COW international trade data (International trade, 1870-2006, version 2.0) (Barbieri, et al. 2008). COW international trade data cover bilateral trade with destinations all over the world from 1870 to 2006.
http://www.correlatesofwar.org/COW2%20Data/Trade/Trade.html

Currency dummies

If the two countries share a common currency through participation in a currency union or are tightly linked by currency blocs in the inter-war period, then the corresponding currency dummy takes the value unity. Our paper focuses on major currency unions/blocs among the 21 countries in our sample as follows:

● The Latin currency union ("*Latin*" in result Tables) (1865-1927): France, Belgium, Italy, Switzerland, Spain

● The Scandinavian currency union ("*Scandinavian*")(1872-1914): Denmark, Norway, Sweden

● The Gold Bloc ("*Gold*"): France, Belgium, Italy, the Netherlands, Switzerland

● The Sterling Area ("*Sterling*"): Great Britain, Australia, Denmark, Finland, Norway, Portugal, Sweden, New Zealand

● The Reichsmark Bloc("*Reichsmark*"): Germany, Austria

● The Dollar bloc ("*Dollar*"): the United States, Canada

● EURO zone area ("*Euro*"): Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain

Asian dummies

● "Asia 1" (Asian and Oceania countries): Australia, New Zealand, Japan, and China

● "Asia 2" (Asia and historical colonial linkages): Australia, New Zealand, Japan, China, France, the United Kingdom, and the Netherlands

● "Asia 3" (Asia and Pacific area countries): Australia, New Zealand, Japan, China, Canada, and United States.

Countries distinguished in the study

We singled out nineteen major countries, which have played an important role in international relations, world economy and politics in 19th and 20th centuries. The countries in our sample are Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Portugal, Spain, Australia, New Zealand, Canada, the United States, Japan, Russia, and China.

APPENDIX: DATING CYCLICAL TURNING POINTS

The cyclical turning points are dated in the series of cyclical deviates by the following criteria:

1. Peaks (P) and troughs (T) must alternate
2. A peak is declared at time "t" when the adjacent observations for $t-k$ and $t+k$ are smaller in (algebraic)value than at t, k having a minimum value of 1
3. A peak cannot be sustained for a negative value of the cyclical deviate nor a trough for a positive one
4. In the event of potential ties produced by following the above rules the larger positive value will be recognised from a potential tie of Ps and the larger negative value will be recognized from a potential tie of Ts.
5. No minimum phase (or cycle) duration constraint has been imposed and no amplitude constraint has been applied.

Table 1: Cross-correlations in the first globalization.

Country	Austria	Bergium	Denmark	Finland	France	Germany	Italy	Netherlanc	Norway	Sweden	Switzerlan	UK	Portugal	Spain	Australia	NewZealar	Canada	USA	Japan	Russia
Austria																				
Bergium	0.5228																			
Denmark	−0.2573	0.0327																		
Finland	0.2049	0.3545	0.0856																	
France	0.4823	0.5283	−0.0573	0.1376																
Germany	0.6006	0.7154	−0.1298	0.4515	0.4768															
Italy	0.1083	−0.0082	0.2384	0.2785	0.1974	0.0298														
Netherlanc	0.2397	0.2993	−0.2774	0.1827	0.162	0.2713	−0.2146													
Norway	−0.0466	0.2113	−0.0862	0.0695	0.1956	0.0512	−0.0844	0.2591												
Sweden	0.0469	0.4476	0.0652	0.5226	0.1004	0.3917	−0.1079	0.1588	0.2585											
Switzerlan	0.0099	−0.0234	0.0373	−0.0145	0.0997	0.112	0.0314	0.1076	0.194	0.0783										
UK	0.242	0.284	−0.1091	0.3165	0.271	0.0982	0.0087	0.3414	0.1538	0.336	0.0926									
Portugal	0.0612	0.1445	0.0471	0.2176	0.0891	0.3175	0.1625	0.0556	−0.0286	0.2263	−0.0562	−0.0903								
Spain	0.1137	0.0947	−0.2287	−0.1746	0.1671	−0.0397	0.0614	0.3493	0.223	0.0413	−0.3818	−0.0043	0.1488							
Australia	0.0368	0.178	0.0142	0.219	0.1442	0.2915	0.0703	0.0626	−0.0892	0.1762	−0.1087	0.2443	0.1904	−0.0635						
NewZealar	0.0573	0.2454	−0.0552	−0.0757	0.1091	0.1853	−0.1527	0.1577	0.034	0.43	0.0842	0.1898	0.3543	0.0719	0.156					
Canada	0.3589	0.3777	−0.2308	0.0332	0.2888	0.2757	−0.0267	0.2478	0.2588	0.2662	0.0598	0.4445	0.1942	0.2198	0.0173	0.1603				
USA	0.342	0.3322	−0.0378	0.008	0.1618	0.2332	0.0146	0.2777	0.1741	0.1987	0.2547	0.1611	0.0705	0.2098	−0.103	0.2152	0.4653			
Japan	0.2879	0.154	−0.0245	0.2645	0.1985	0.124	0.3685	0.1382	−0.0688	−0.017	0.1769	0.0967	0.1513	0.1935	0.1437	−0.1278	0.0923	0.1122		
Russia	0.0735	0.0336	−0.2019	−0.085	0.0261	0.1784	−0.2068	0.0077	−0.1391	−0.2427	−0.2387	−0.0738	0.0275	−0.1347	−0.0034	−0.1391	−0.0455	−0.3393	−0.1783	
China	−0.0406	−0.0583	−0.2562	−0.3435	0.1001	−0.0664	−0.1929	0.0158	0.4	−0.0956	−0.1005	−0.2458	−0.1896	0.1136	0.0731	0.1542	0.1045	0.1226	−0.308	0.1512

Table 2: Cross-correlations in the bloc economy.

Country	Austria	Bergium	Denmark	Finland	France	Germany	Italy	Netherlanc	Norway	Sweden	Switzerlan	UK	Portugal	Spain	Australia	NewZealar	Canada	USA	Japan	Russia
Austria																				
Bergium	−0.064																			
Denmark	0.2253	0.5114																		
Finland	0.2346	0.6926	0.5361																	
France	−0.0217	0.6845	0.5148	0.4561																
Germany	0.5094	−0.109	−0.1126	0.0852	−0.5119															
Italy	0.5277	−0.2436	−0.0458	−0.1713	0.2444	−0.1214														
Netherlanc	0.1009	0.308	0.1831	0.2853	0.7594	−0.5539	0.5321													
Norway	−0.1865	0.6044	0.3679	0.4701	0.694	−0.3849	0.0334	0.6213												
Sweden	0.0562	0.6158	0.653	0.6923	0.6073	−0.1706	−0.0447	0.3968	0.6763											
Switzerlan	−0.5724	0.5241	0.0782	0.2284	0.5434	−0.4688	−0.2146	0.3402	0.68	0.4563										
UK	0.3203	−0.4535	−0.3165	−0.1501	−0.3498	0.3775	0.4167	−0.1657	−0.2163	−0.1227	−0.2889									
Portugal	0.1982	0.2376	0.3041	0.3424	0.1983	−0.0225	0.0624	0.1175	0.1599	0.1252	0.1168	−0.0701								
Spain	0.2069	0.0319	−0.0975	0.0595	−0.0449	0.0959	0.1232	−0.099	−0.1268	0.0173	−0.0813	0.095	0.1489							
Australia	0.3908	−0.019	−0.1419	0.4599	−0.1585	0.4837	0.1177	−0.0019	−0.0529	0.1216	−0.2519	0.446	0.0672	0.1525						
NewZealar	−0.0089	0.3211	0.4205	0.4204	0.4307	−0.1149	−0.008	0.3052	0.4341	0.5637	0.284	−0.0657	−0.1119	−0.2428	0.2111					
Canada	0.269	−0.0938	−0.0478	0.1225	−0.1354	0.3427	0.3505	−0.0915	0.0021	0.2394	−0.1026	0.7121	−0.0426	0.1537	0.3845	0.1337				
USA	0.1998	−0.1444	0.0834	0.1941	−0.4625	0.6103	−0.1362	−0.4844	−0.2245	0.2086	−0.2996	0.5283	−0.149	−0.0396	0.4561	0.1104	0.6282			
Japan	0.8801	−0.1025	0.1863	0.2377	−0.0451	0.4031	0.5451	0.1383	−0.1583	−0.0361	−0.5754	0.2613	0.1639	0.2737	0.4549	−0.0328	0.2156	0.1974		
Russia	0.2761	0.3964	0.3967	0.3014	0.1304	0.3002	−0.1529	−0.1411	0.0466	0.2183	0.0434	−0.061	0.0909	−0.1154	−0.0056	0.1148	0.0531	0.1257	0.0989	
China	0.1942	−0.0783	0.0648	0.008	−0.0205	0.1312	0.265	0.1265	−0.0135	0.0524	−0.2824	0.1135	−0.3219	−0.085	0.1564	0.0639	0.2135	0.2765	0.3359	0.0737

Table 3: Cross-correlations in the second globalization.

Country	Austria	Bergium	Denmark	Finland	France	Germany	Italy	Netherlanc	Norway	Sweden	Switzerlan	UK	Portugal	Spain	Australia	NewZealar	Canada	USA	Japan	Russia
Austria																				
Bergium	0.6233																			
Denmark	0.3249	0.3189																		
Finland	0.3919	0.5956	0.1557																	
France	0.7103	0.7753	0.3027	0.5122																
Germany	0.4354	0.5377	0.5622	0.2433	0.5345															
Italy	0.2453	0.506	0.188	0.2541	0.4189	0.259														
Netherlanc	0.4157	0.5765	0.425	0.2076	0.5145	0.5061	0.301													
Norway	−0.0976	−0.0204	0.4846	−0.08	−0.3262	0.1426	0.1393	0.1858												
Sweden	0.2872	0.586	0.2194	0.7046	0.3574	0.2714	0.2851	0.4	0.0389											
Switzerlan	0.6301	0.6613	0.1414	0.556	0.648	0.3896	0.4207	0.4198	−0.0329	0.3119										
UK	0.192	0.3042	0.522	0.4453	0.4144	0.3938	0.3074	0.2764	0.1516	0.3432	0.1946									
Portugal	0.5323	0.6058	0.1372	0.4067	0.6952	0.3395	0.4556	0.3014	−0.1778	0.1276	0.5692	0.4592								
Spain	0.4092	0.6207	0.0261	0.5485	0.6203	0.1447	0.4647	0.2272	−0.2032	0.4424	0.3867	0.2832	0.4511							
Australia	−0.046	0.3291	0.1736	0.4288	0.2253	0.2778	0.2574	0.5249	0.1214	0.5518	0.267	0.4067	0.1907	−0.0074						
NewZealar	0.013	0.1457	0.1723	0.3809	−0.0044	0.1246	−0.134	−0.0914	0.1012	0.2673	0.0901	0.1506	−0.1839	0.077	0.1409					
Canada	0.0396	0.2753	0.3598	0.38	0.2699	0.416	0.2586	0.4451	0.3241	0.341	0.2494	0.6029	0.2279	0.1543	0.6715	0.3533				
USA	0.1098	0.2014	0.4968	0.1702	0.3237	0.4623	0.2362	0.4729	0.3678	0.0468	0.2078	0.6547	0.3039	0.0974	0.4124	0.1494	0.823			
Japan	0.3544	0.4282	0.3383	0.3893	0.4084	0.3233	0.493	0.2205	−0.0408	0.2226	0.3573	0.3538	0.4143	0.3602	0.1162	−0.1688	0.0624	0.2655		
Russia	0.2066	0.3784	0.122	0.497	0.4618	0.0853	0.1604	0.2358	−0.2374	0.3638	0.184	0.4871	0.3881	0.452	0.1982	0.0539	0.2885	0.2176	0.2447	
China	−0.2469	−0.1094	0.2309	0.0968	−0.1878	0.2864	−0.3174	−0.03	0.283	0.0975	−0.1246	0.3575	−0.202	−0.3879	0.3596	0.3751	0.376	0.2677	−0.2017	−0.1281

Table 4: Business Cycles: Stylized Facts

First Globalization (1890-)

Country Code	Austria	Bergium	Denmark	Finland	France	Germany	Italy	Netherlan	Norway	Sweden	Switzerlar	UK	Portugal	Spain	Australia	NewZeala	Canada	USA	Japan	Russia	China
Number of cycles P-P	5	4	4	5	6	5	9	4	5	5	7	5	6	6	8	5	7	8	6	6	6
Number of cycles T-T	4	4	5	5	5	5	9	4	5	5	7	5	6	5	7	6	6	7	6	6	5
Average Expansion Probability	0.41	0.55	0.56	0.67	0.60	0.59	0.40	0.59	0.50	0.48	0.55	0.60	0.60	0.43	0.45	0.55	0.55	0.50	0.31	0.590909	0.6
Average Recession Probability	0.59	0.45	0.44	0.33	0.40	0.41	0.60	0.41	0.50	0.52	0.45	0.40	0.40	0.57	0.55	0.45	0.45	0.50	0.69	0.409091	0.4
Average Duration of Expansions	1.80	2.40	2.00	2.33	2.00	2.17	1.20	2.60	2.00	1.67	1.38	2.00	1.71	1.50	1.25	2.00	1.71	1.25	1.29	1.857143	2
Average Duration of Recessions	2.60	2.50	1.60	1.40	1.33	1.80	2.00	2.25	2.00	2.20	1.29	1.60	1.33	2.00	1.50	1.67	1.43	1.25	3.33	1.5	1.333333
Average Amplitude of Expansior	0.042	0.011	0.013	0.033	0.049	0.028	0.034	0.025	0.013	0.022	0.030	0.022	0.020	0.039	0.044	0.048	0.036	0.051	0.053	1.63821	0.22492
Average Amplitude of Recessior	0.031	0.007	0.016	0.025	0.035	0.018	0.033	0.019	0.012	0.021	0.026	0.016	0.017	0.039	0.052	0.049	0.038	0.053	0.047	1.463064	0.230906

Bloc Economy

Country Code	Austria	Bergium	Denmark	Finland	France	Germany	Italy	Netherlan	Norway	Sweden	Switzerlar	UK	Portugal	Spain	Australia	NewZeala	Canada	USA	Japan	Russia	China
Number of cycles P-P	9	10	10	11	9	8	10	13	10	11	11	9	13	13	7	11	10	10	11	9	8
Number of cycles T-T	8	10	10	11	8	8	10	13	10	11	11	9	13	12	8	12	10	10	11	10	9
Average Expansion Probability	0.48	0.45	0.67	0.66	0.63	0.67	0.63	0.63	0.66	0.66	0.66	0.64	0.67	0.66	0.72	0.66	0.65	0.65	0.65	0.538462	0.594595
Average Recession Probability	0.52	0.55	0.33	0.34	0.38	0.33	0.37	0.38	0.34	0.34	0.34	0.36	0.33	0.34	0.28	0.34	0.35	0.35	0.35	0.461538	0.405405
Average Duration of Expansions	1.30	1.64	4.00	3.64	4.38	4.88	3.60	3.08	4.00	3.64	3.73	4.11	3.08	3.17	4.33	3.33	3.90	4.10	3.64	1.909091	2.444444
Average Duration of Recessions	1.56	1.83	1.82	1.75	2.33	2.11	1.91	1.71	1.91	1.75	1.75	2.10	1.54	1.54	1.88	1.75	1.91	2.00	1.83	1.636364	1.666667
Average Amplitude of Expansior	0.109	0.051	0.064	0.058	0.085	0.119	0.064	0.064	0.056	0.036	0.049	0.036	0.052	0.047	0.032	0.073	0.056	0.071	0.082	1.884386	0.290513
Average Amplitude of Recessior	0.103	0.057	0.063	0.062	0.086	0.116	0.068	0.068	0.058	0.038	0.051	0.040	0.055	0.047	0.031	0.069	0.059	0.069	0.083	1.919864	0.31891

Second Globalization

Country Code	Austria	Bergium	Denmark	Finland	France	Germany	Italy	Netherlan	Norway	Sweden	Switzerlar	UK	Portugal	Spain	Australia	NewZeala	Canada	USA	Japan	Russia	China
Number of cycles P-P	10	11	9	7	8	9	7	8	12	8	8	8	9	8	9	11	10	9	9	11	9
Number of cycles T-T	9	11	8	6	7	8	6	8	11	7	7	7	9	7	9	10	10	9	8	10	8
Average Expansion Probability	0.65	0.48	0.39	0.44	0.50	0.63	0.51	0.59	0.54	0.51	0.56	0.53	0.63	0.53	0.61	0.59	0.64	0.62	0.54	0.486486	0.578947
Average Recession Probability	0.35	0.52	0.61	0.56	0.50	0.37	0.49	0.41	0.46	0.49	0.44	0.47	0.37	0.47	0.39	0.41	0.36	0.38	0.46	0.513514	0.421053
Average Duration of Expansions	2.40	1.75	1.67	2.43	2.38	2.67	2.71	2.56	1.75	2.50	2.75	2.86	2.40	2.38	2.30	2.09	2.27	2.40	2.33	1.636364	2.444444
Average Duration of Recessions	1.30	1.77	2.56	3.14	2.38	1.56	2.57	2.00	1.50	2.38	2.13	2.25	1.40	2.13	1.67	1.45	1.40	1.67	2.00	1.727273	2
Average Amplitude of Expansior	0.014	0.016	0.018	0.023	0.010	0.018	0.013	0.014	0.014	0.017	0.017	0.016	0.021	0.011	0.017	0.027	0.017	0.018	0.020	3.277044	0.707625
Average Amplitude of Recessior	0.013	0.016	0.017	0.022	0.009	0.016	0.014	0.012	0.014	0.015	0.016	0.015	0.022	0.011	0.016	0.025	0.016	0.017	0.022	3.086556	0.701796

Average Numbers of Cycles P-P and T-T in Each Period

	Average P-P	Average T-T	Per-year P-P	Per-year T-T
First Globalization Period	5.80952	5.57143	0.23238	0.22286
Bloc Economy Period	10.1429	10.1905	0.2254	0.22646
Second Globalization Period	9.04762	8.33333	0.21542	0.19841

See Appendix Table A for country code.

Table 5: Business Cycle Synchronization

First Globalization

	coef	t-value	coef	t-value	coef	t-value
Trade	0.000925	2 **	0.000925	2 **	0.000982	2.22 **
GDP			0.007008	0.54	0.010988	0.78
Scandinavian					0.117775	1.86 *
Latin					-0.0818	-1.17
Sample	130		130		130	
F	11.98		11.98		17.72	
R-squared	0.5094		0.5094		0.5212	

Bloc Economy

	coef	t-value	coef	t-value	coef	t-value
Trade	8.26E-06	0.39	8.26E-06	0.39	4.02E-06	0.2
GDP			-0.01774	-0.88	-0.02932	-1.45
Gold					0.391547	3.05 **
Stering					-0.03944	-0.5
Dollar					0.560975	6.17 **
Reichsmark					-0.17552	-1.11
Sample	210		210		210	
F	1.99		1.99			
R-squared	0.128		0.128		0.2033	

Second Globalization

	coef	t-value	coef	t-value	coef	t-value
Trade	0.001507	2.2 **	0.001507	2.2 **	0.001059	1.48
GDP			0.047869	3.29 **	0.047849	3.6 **
Euro					0.219876	4.59 **
Sample	210		210		210	
F	4.34		4.34		6.18	
R-squared	0.4004		0.4004		0.456	

Table 6: Euro and Causality

	1		2	
Sample Period	First Globalization		Bloc Economy	
	coefficient	t-value	coefficient	t-value
Trade	0.00079	1.7 *	4.52E-06	0.22
GDP	0.00967	0.71	-0.029382	-1.45
EURO	0.0934	1.64 *	-0.015869	-0.21
Scandinavian	0.08936	1.39		
Latin	-0.09334	-1.36		
Gold			0.3944686	3.07 **
Stering			-0.039408	-0.5
Dollar			0.5642234	6.1 **
Reichsmark			-0.178139	-1.14
Sample	130		210	
F	16.27			
R-squared	0.534		0.2035	

Table 7: Asian Business Cycle

First Globalization

	coef	t-value	coef	t-value	coef	t-value
Trade	0.00105	2.16 **	0.001102	2.47 **	0.001069	2.41 **
GDP	0.006647	0.52	0.010664	0.76	0.014779	1.01
Asia 1	-0.30294	-4.28 **	-0.29721	-4.2 **		
Asia 2					-0.0487	-0.86
Scandinavian			0.118918	1.87 *	0.125667	1.95 *
Latin			-0.07731	-1.11	-0.08291	-1.2
Sample	130		130		130	
F					15.32	
R-squared	0.5243		0.5356		0.5241	

Bloc Economy

	coef	t-value	coef	t-value	coef	t-value
Trade	7.81E-06	0.37	8.66E-06	0.42	4.83E-06	0.24
GDP	-0.01522	-0.73	-0.01774	-0.88	-0.02928	-1.44
Asia 1	0.073368	0.75				
Asia 2			0.029953	0.34	0.056129	0.68
Gold					0.395022	3.04
Stering					-0.03695	-0.47
Dollar					0.574118	6.35
Reichsmark					-0.1762	-1.1
Sample	210		210		210	
F	1.92		1.9			
R-squared	0.1294		0.1286		0.2054	

Second Globalization

	coef	t-value	coef	t-value	coef	t-value
Trade	0.001436	2.06 **	0.001425	2 **	0.001025	1.4
GDP	0.050383	3.58 **	0.035437	1.67 *	0.04099	2.08 **
Asia 1	0.075025	0.56				
Asia 3			0.08549	0.98	0.04716	0.58
Euro					0.21429	4.56 **
Sample	210		210		210	
F	4.58		4.46		6.09	
R-squared	0.4026		0.406		0.456	

Table A: Cross-correlations in Inter-war period (1915-1945).

Country	Austria	Bergium	Denmark	Finland	France	Germany	Italy	Netherlanc	Norway	Sweden	Switzerlan	UK	Portugal	Spain	Australia	NewZealar	Canada	USA	Japan	Russia
Austria																				
Bergium	−0.0788																			
Denmark	0.297	0.5286																		
Finland	0.2221	0.7021	0.5821																	
France	0.0786	0.7107	0.5193	0.5081																
Germany	0.3775	−0.1152	−0.0579	0.0703	−0.447															
Italy	0.5963	−0.2682	−0.0635	−0.1696	0.2422	−0.1646														
Netherlanc	0.2129	0.2951	0.1583	0.3301	0.7402	−0.5393	0.542													
Norway	−0.186	0.6113	0.3837	0.5046	0.7226	−0.4659	−0.0185	0.6064												
Sweden	0.1286	0.6187	0.6644	0.7239	0.5938	−0.0524	−0.041	0.3857	0.7072											
Switzerlan	−0.5902	0.5489	0.0779	0.2684	0.544	−0.4093	−0.3137	0.2591	0.681	0.4514										
UK	0.242	−0.4906	−0.3172	−0.2059	−0.3054	0.2857	0.485	−0.1132	−0.2004	−0.0894	−0.2458									
Portugal	0.2628	0.2247	0.3067	0.3696	0.1888	0.0668	0.0309	0.0691	0.1151	0.1116	0.0244	−0.0575								
Spain	0.2894	0.0403	−0.0505	0.0589	−0.0461	0.2145	0.1473	−0.0813	−0.137	0.0064	−0.1629	0.1534	0.1674							
Australia	0.2727	−0.0213	−0.1313	0.4771	−0.0534	0.3052	0.1629	0.1418	0.0115	0.2064	−0.1524	0.3764	0.1229	0.2317						
NewZealar	0.0299	0.3733	0.4271	0.5434	0.4922	−0.1073	−0.0407	0.3314	0.527	0.6494	0.3476	−0.0406	−0.1996	−0.2521	0.2801					
Canada	0.2724	−0.0903	−0.0167	0.1333	−0.09	0.3747	0.3857	−0.0289	0.0263	0.2806	−0.1116	0.7699	−0.0349	0.1363	0.4014	0.2044				
USA	0.1087	−0.1374	0.1514	0.1955	−0.3783	0.5483	−0.1084	−0.3924	−0.176	0.3156	−0.2448	0.5062	−0.1264	−0.0496	0.376	0.2348	0.6292			
Japan	0.8904	−0.0962	0.2562	0.2387	0.0737	0.2348	0.5909	0.2748	−0.1544	0.0406	−0.6031	0.2027	0.2109	0.3237	0.3976	0.0484	0.1843	0.0854		
Russia	0.1548	0.4465	0.4888	0.3349	0.2118	0.165	−0.1939	−0.1404	0.0718	0.313	0.1786	−0.1522	0.147	−0.0746	−0.176	0.1278	0.0225	0.0856	0.0059	
China	0.179	−0.0569	0.1038	0.0442	0.0934	−0.1181	0.3415	0.3594	0.0446	0.1729	−0.2806	0.1885	−0.3788	−0.1302	0.1163	0.2107	0.2274	0.275	0.3328	−0.0897

Figure 1: Business Cycles

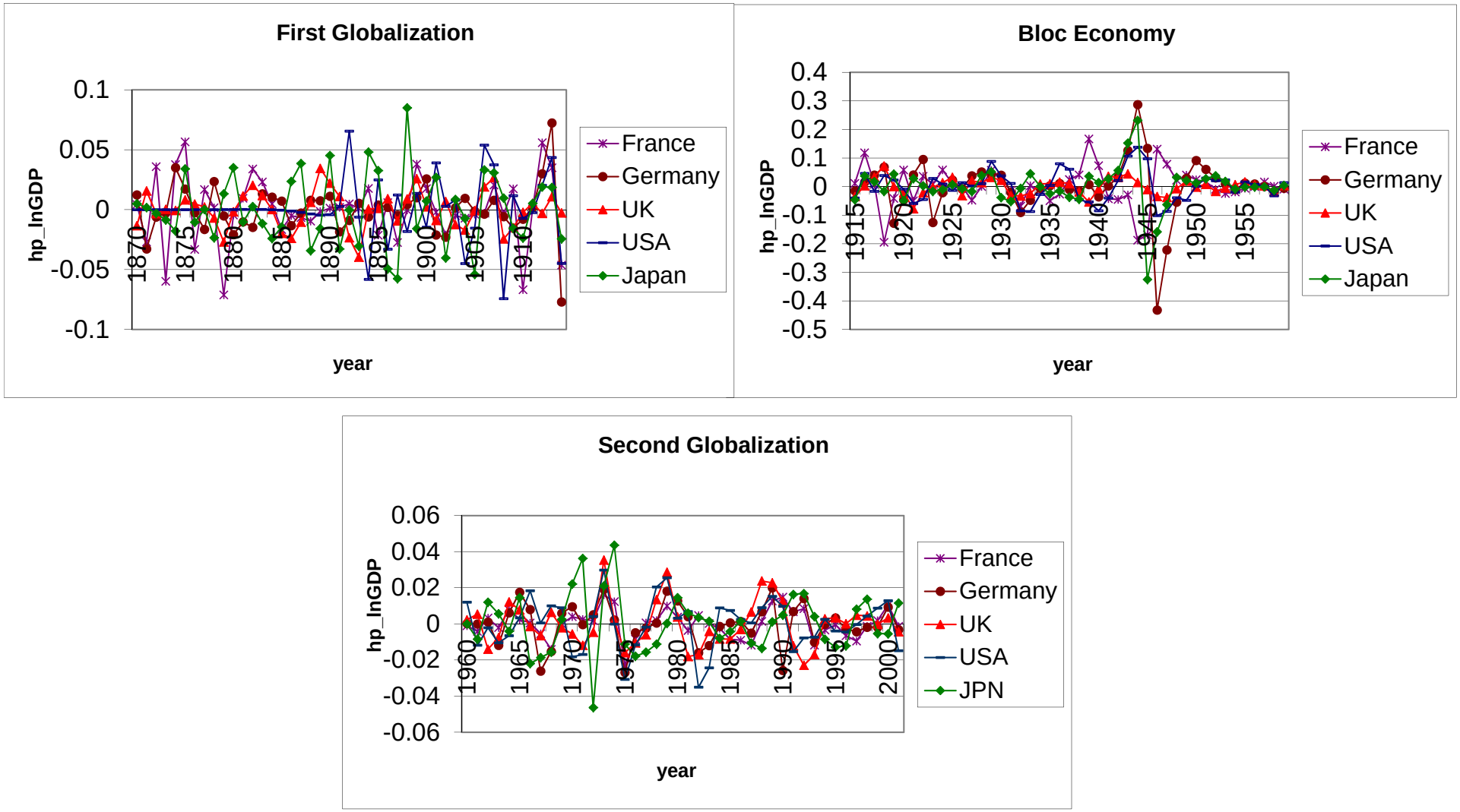

Figure 2: Histogram of cross-correlations