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GLOBALIZATION AND BUSINESS CYCLE TRANSMISSION

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ABSTRACT

Globalization and Business Cycle Transmission*

The paper uses long-run GDP data for developed countries drawn from Maddison (2003) to generate deviation cycles for the period from 1870 to 2001. The cyclical deviates are examined for their bilateral cross-correlation values in three separate periods, those of the first globalization wave (1870 to 1914), the period of the “bloc economy” (1915 to 1959) and for the period of the second globalization (1960-2001). Cluster analysis is applied and the McNemar test is used to test for the relative coherence of alternative groupings of countries in the three periods. The bloc economy period emerges as one that features some well-defined sub-global clusters, where the second globalization period does not, the first globalization period lying between the two in this respect. The second globalization period shows a generally higher level of cross correlations and a lower variance than the other two periods. The features uncovered suggest that the second globalization period is indeed one that comprises a more inclusive world economy than ever before

JEL Classification: E32, F0, F15, F41 and N10

Keywords: bloc economy, business cycle, cluster analysis, globalization and McNemar test

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1. Introduction

It has become generally agreed that two waves of globalization can be detected – one situated before World War I, and the other commencing at some point in the period from the 1960s after World War II to the current period. Explorations of two-wave-globalization themes (e.g. Bairoch and Kozul-Wright, 1996; Baldwin and Martin, 1999; Williamson, 2002) have emphasized that openness in trade and finance are the principal *common* characteristics of the two waves; in some other ways – e.g. the scale of international migration and investment, the role of government and its policies and the presence of international organizations and international cooperation and coordination in economic policies – the two waves are not the same. Openness in trade and finance have come to be regarded as positive indicators of business cycle transmission between economies and it is this understanding which has prompted us to use the long run real GDP series that Maddison (2003) has made available for many countries all over the world as the basis for identifying business cycles and their synchronization.¹ The paper aims to discuss how the two waves of globalization and the intervening period - which we term the period of the bloc economy - are reflected in business cycle transmission. Indeed, for many observers the essence of globalization is the participation of many individual countries in a world business cycle. *Per contra*, in the era of the bloc economy it may well be the case that a common business cycle experience is experienced only by subsets of the world's economies reflecting the formation of political alliances, and exclusive trade and currency areas.

In detail, our paper proposes the identification of deviation cycles in the available data by appropriate filtering methods and then to make comparisons of the similarity of cycles in the two globalization periods (and the contrast, perhaps, with the experience of the period between the two waves). Synchronicity is most simply explored by computing the bilateral cross-correlation coefficients of the cyclical deviates as in Artis and Okubo (2008 a,b); this bilateral approach can be extended by following the example set by Bovi (2005) who showed how the McNemar test statistic can be

¹ The data sets provided by Maddison (1995, 2003) cover real GDP and population in Europe, North America, South America, Asia, Oceania and Africa from 1820 to 2001 at maximum.

computed to compare the behaviour of groups of economies. Clustering techniques can also be employed to highlight the similarities of cyclical experience as in Camacho et al. (2008) and Crowley (2008). It would be desirable to complement these comparisons, which are essentially based on measures of synchronicity, with measures of other cyclical characteristics (amplitude, for example), as Camacho et al. (2008) and Crowley (2008) have recently shown in the context of an examination of cycles in European countries².

Our scope of research is developed countries over three periods. Following the definition of globalization in Bairoch and Kozul-Wright (1996) and Baldwin and Martin (1999), the first wave of globalization is defined as the period before World War I (i.e. 1870- 1914). The bloc economy period (1915-1959) comprises the inter-war period, which involves the Great Depression, World War II and the subsequent recovery period. Then the second wave of globalization is defined as the period after 1960. After World War I, some East European countries became independent. After World War II, many Asian countries won independence from the Imperial powers. The 1960s saw the independence of many more formerly colonial African and Asian countries and the initiation of the movement of international cooperation and liberalization of trade and finance, which is the period of the establishment of the current regime of international relations. Our study focuses on some major developed countries. Those that we single out (see Appendix Table A) satisfy three conditions: the first is that annual GDP data are available for them; the second is that they have been regarded as a big power with an important role to play in the international economy and international politics in the 19th and 20th centuries; the third, finally, is that they have been an independent nation for almost all the periods we are concerned with, without experiencing a big change of boundary nor substantial domination by foreign powers.³

² As we note more extensively in our conclusions this area might be highly suited to an application of wavelet analysis, though this is beyond the scope of the present paper.

³ We note that Maddison's real GDP data set (1990 international Geary-Khamis dollars) includes some shortcomings. The change in the terms of trade is not taken into account and thus a deviation from the real value may occur in the early period when there has been a long-term deterioration in the terms of trade.

Literature Review

Numerous studies of globalization have been undertaken from many different angles.⁴ Within the field of international economics and trade there are several outstanding studies; some that take a long run view and a historical perspective include Bairoch and Kozul-Wright (1996), Williamson (1996, 2002), Rodrik (1997), Baldwin and Martin (1999) and Bordo, Eichengreen and Irwin (1999).

A standard measure of globalization is that of trade openness, defined as the share of import and export values in GDPs.⁵ The trade openness measure indicates the two waves of globalization we have already defined. The first period is until 1914 and the second one is from 1960 to the current day. However, these two waves of the globalization are fundamentally different in many aspects, i.e. political system/regime (democracy, colonialism, and human right), international relations (international cooperation and aid of development), international organizations/institutions/rules (the WTO/GATT and the IMF), and economic systems (market mechanism, the role of government, fiscal and monetary policies and trade and investment policies or regulations). Related to our main issue of international business cycle transmission, Baldwin and Martin (1999), for example, suggested many different international economic features in capital and trade flows, which has been a key in the international linkage of economies. 1) Capital flows have a substantially different nature with enormous short-term flows in the second globalization wave, driven by the advancement of information technology. 2) Foreign direct investment (FDI) has substantially different features: FDI among developed countries in manufacturing as well as service sectors are outstanding in the second globalization wave. 3) Trade flows have different features: intra-industry trade promoted by scale economies and product differentiation is active in the current globalization. 4) Income convergence and divergence have a different tendency: the second wave of globalization has witnessed income convergence among only leading nations, coupled with de-industrialization and a rapid speed of industrialization among only some developing countries. 5) Tariff rates, transportation and communication costs have drastically

⁴ Scholte (2007) surveyed several definitions and discussions concerning globalization. See also Scholte (2000). Whalley (2007) studied how globalization affects social value.

⁵ See Dreher, et al. (2008) for a lot of definitions and measurement of globalization.

fallen over decades and remained substantially very low in the second globalization period.

Apart from two-wave globalisation studies, there are many analyses of specific issues in specific periods, especially of the effect of trade protection and the formation of currency and trade blocs. There exists some similarity between the bloc economy period and the second globalization wave in at least one salient respect. This is often discussed in the current wave of sub-global economic integration and currency unions, which is different from the first wave globalization but somewhat similar to the bloc economy period. The institutional promotion of sub-global economic integration can more or less bias trade flows (see e.g. Kindleberger, 1973 for a discussion of the inter-war exclusive bloc economies), which hampers international business cycle synchronization and would negatively affect globalization. In the international trade literature, some studies use the gravity model and examine the transmission of international relationship through economic integration. For example, Rose (2000) and Rose and Wincoop (2000) measured the effect of currency unions in recent decades on trade flows. Krueger (1999, 2000) and Soloaga and Winters (2001) studied the impact of current economic integration on trade flows. Similarly, Gowa and Kim (2005) studied the impact of the GATT on trade flows. Using historical data sets, Eichengreen and Irwin (1995) provided some evidence on how exclusive the bloc economy in the inter-war period was in its effect on trade flows. Finally, turning to the business cycle literature, as Heathcote and Perri (2002), Kose, Prasad and Terrones (2003), Baxter and Kouparitsas (2004) and Inklaar et al. (2008) studied how increased trade and/or financial integration has led to international business cycle synchronization in the post-war period. They found an increase of synchronization over time in industrialized nations.⁶ They indicate that globalization promotes international economic linkages and heightened business cycle correlations. Therefore, this paper adopts the synchronization of cyclical deviates as the measurement of globalization.

⁶ Flandreau and Maurel (2005) studied the business cycle in the 19th century.

The paper is organized into four sections. The next section discusses the identification of the business cycle and its synchronisation. Section 3 provides some statistical analyses. Then finally section 4 provides some conclusions.

2. Identifying Cycles and Stylized Facts

Business cycle literature recognizes two types of cycle. One type of cycle is known as the “classical” cycle, which can be recognized from the fact that it involves an *absolute* decline in economic activity from the peak and an *absolute* rise in activity from the trough.⁷ Clearly such cycles do not exist in growth economies and they are relatively rare for world economies over the last centuries. The other type of cycle, which is our focus, is a deviation or growth (occasionally growth *rate*) 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 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 annualization of the data. 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.⁸ The filter has been applied to the log of the GDP series for each country.

Figures 1-3 show the HP-filtered GDP cycles for three 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.

⁷ In the recent years the NBER for the United States and the CEPR for the EuroArea provide chronologies of such cycles.

⁸ 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).

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. Figures 4-6 show 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 keep quite high positive correlations even around 0.7 to 0.8. This might suggest that some allied bloc-members are positively correlated, while countries without alliances are negatively correlated. This two-hump shape of the histogram might reflect how closed and exclusive the bloc economy was. Now, Figures 7-9 shows the same cross-correlations from a different angle. First of all, as seen in Figure 7, the first wave of globalization has lower correlations with small variances, but the range of correlations is more widely spread in the bloc economy period. The average as well as variance is widely spread. There are many samples which switch from negative correlations to positive or from positive to negative correlations. Not a few pairs seem to drastically change their international relationship. Next, as shown in Figure 8, many country pairs increase their cross correlations from the bloc economy to the second globalisation period. Many are changed from negative to positive correlations, whilst the opposite change of direction is rarely observed. Finally, compared with the first globalisation period, the second sees a higher average and larger variance (Figure 9). This implies that the second globalization economies are much more correlated with each other than they are in any other period, although there remains some variance around even these close correlations.

3. Empirical Analyses

Now we conduct a more detailed econometric analysis to study business cycle synchronization in the three periods. Here, we provide two statistical analyses: one

based upon a dendrogram clustering analysis associated with two types of stopping rules and the other on the use of the McNemar test statistic à la Bovi (2005).

3. 1 Dendrogram clustering analysis

This section investigates average linkage cluster analysis, using the deviation cycles of the HP-filtered GDPs identified in the last section. Hard clustering analysis is associated with a graphical picture (a dendrogram) which shows how an “object” (a country in our case) can be associated with others in respect of some pre-selected characteristic. In our case that “characteristic”, x_{ki} , is a measure of country i 's HP-filtered GDP correlation with all other countries (k). The clustering algorithm will seek to associate other countries, j , with country i on the basis of minimizing the distance between them in respect of the chosen characteristic. The measure of distance between countries i and j is the Euclidean, i.e.

$$d_{ij} = \sqrt{\sum_{k=1}^{19} (x_{ki} - x_{kj})^2} .$$

A clustering algorithm then proceeds in an iterative manner, replacing the first cluster (i and j) found by a replacement value in order to proceed to the next round and so on (in our case the replacement value is the average of the two countries' values). The resultant dendrogram (Hierarchical average-linkage cluster tree) (see Figures 10-12) gives a basis for determining by eye a number of clusters which can alternatively be found by applying a formal stopping rule. In the dendrograms shown in Figures 10-12, where the countries in the horizontal axes are identified by country code given in the Appendix table, the eye suggests that the United Kingdom, the United States and Canada (these are country numbers 12, 18 and 17) are strongly clustered in all three periods. This is not surprising as the three have long been highly linked with one another through race, political alliances, migration, language and culture. Similarly, three Scandinavian countries such as Denmark, Finland and Sweden (indicated by country numbers 3, 4, 10) are also strongly tied in all three periods. This seems to be owing to cultural similarity. Furthermore, due to geographical proximity, Portugal and Spain are closely linked and France and Belgium are also clustered in all periods. By contrast, other peripheral or small countries are likely to be outsiders to the world

economy, roughly saying Austria, Switzerland, Japan and New Zealand. In sum, clustering might reflect not only international political and economic relationship but also geographical distance, cultural and language difference from other developed countries.

Turning to the change of the dendrogram for three periods, while the first globalization and the second globalization look like one cluster with some outsiders, the bloc economy is clearly split the two groups. The United States, the United Kingdom, Australia and Canada (namely, Anglo-Saxon countries) are clustering and substantially far from major continental European countries (France, Belgium Germany, the Netherlands) as well as Scandinavian countries in the bloc economy period. This might depict the exclusive behaviors due to currency bloc, trade bloc and wars. But it is clear that the dendrogram for the bloc economy period looks different from those for the other two periods. We can also see what the application of formal clustering rules says.

3.2 Cluster-analysis stopping rules

Here, using the same data sets, we adopt two types of stopping rules: the Calinski and Harabasz (1974) pseudo- F index and the Duda-Hart (1973) pseudo- T -squared index. Larger pseudo- F and smaller pseudo- T -squared values indicate more distinct clustering. Kaufman and Rousseow (1990) provided a good general guide to cluster-diagnostics. Table 4 reports the results for the three periods. It shows the candidate numbers of clusters and two test values.⁹ The first globalization period has two or three-group solutions with pseudo- F (i.e. 4.17 for two-group solution and 3.02 for three-group one) and pseudo- T -squared values (i.e. 1.75 for two-group solution and 1.36 for three-group one). The bloc economy has two-group solution with pseudo- F (22.08) and pseudo- T -squared values (3.07). It is noticeable that the absolute values of the pseudo- F statistic are far higher for the bloc economy period than for the other two periods. Different from the first globalization and bloc economy, the second globalization economy has four to eight-group solutions. However, we can say that the second globalization period does not see one substantially high value in pseudo- F and one low value in pseudo- T -squared values in the numbers of clusters. This

⁹ As seen in the Table, a few pseudo- T -squared values are undefined. This could occur when the two subgroups each have no variability.

indicates that it is hard to discern very distinct clusters in this period. In other words, we might be able to say that countries in the second globalization period cooperate and coordinate with one another with creating many vague sub-groups. This result indicates that many regions have many kinds of agreements at regional level, while developed countries cooperate and coordinate economic policies through political negotiations and international organizations promote the coordination. Compared with the second and the first globalization, the bloc economy period sees a substantial split towards two-clustering world. These results are consistent with the informal evidence that can be gathered by looking at the dendrograms, as we did before.

3.3 McNemar test

Turning from cluster analysis, this section studies the relationship of specific (e.g. as defined by language, race and economic relations) groups of countries to others. In this section, we deploy a non-parametric technique to ask a question about the coherence of particular country groups. The procedure involves the “McNemar test” and has been given prominence by Bovi (2005). He uses binary data given by the turning points of the cycle (the peak and trough) and applies the McNemar test to pairs of groups so as to assess whether there is a difference in coherence of the two groups. Importantly, Bovi (2005) studied the classical cycle, while our paper employs the deviation cycle.

The “peak to trough” in our paper is defined as positive value of the HP-filtered GDP (above trend) and conversely “trough to peak” is defined as negative value of the HP-filtered GDP (below trend). Then, the HP-filtered GDP data are transformed to binary data, either 0 or 1. When GDP is from peak to trough, a binary time series variable is given as 0. On the other hand, if the GDP is from trough to peak, the variable is given as 1.

Then “synchronization” is defined as the situation where all countries in a given group are in the same phase (peak or trough). When all countries in a group are either 0 or 1 in the period, they are said to be “in-synch”. In comparing two groups of countries the issue is whether one group is more coherent than another, i.e. “in synch” more often than the members of the other group. The contingency table below

tabulates the frequencies with which group 1 is in synch at the same time as group 2 (N_{11}), is in synch when group 2 is not (N_{12}), is out of synch when group 2 is in synch (N_{21}) or, finally, is out-of-synch when group 2 is also out of synch (N_{22})

		Group 2	
		In-synch	Out-of-synch
Group 1	In-synch	N_{11}	N_{12}
	Out-of-synch	N_{21}	N_{22}

The McNemar test statistic (with a continuity correction suggested by Sheshkin (2002)) is distributed as chi-squared with one degree of freedom and defined as

$$(1) \quad \chi^2(1) = \frac{(|N_{12} - N_{21}| - 1)^2}{N_{12} + N_{21}}$$

A positive and significant value for this statistic would indicate that group 1 is more coherent than group 2.

In these clustering analyses, we need to single out some reasonable criteria for assigning member countries to groups. One method of grouping is by language, race, culture and geographical proximity. One of the most salient groups contains the United States, the United Kingdom and Canada. Another group is that of continental European countries, centred on France and Germany. Another group is composed of Scandinavian countries, Sweden, Norway and Finland.¹⁰ Table 5 reports the results. In the bloc economy period, continental European countries are more coherent than Anglo-Saxon (US-UK-Canadian) group. On the other hand, the Scandinavian country group is more coherent in the second globalisation period than the Anglo-Saxon country group (Test 3). Finally, we involve a larger-sized group (Test 5). One is the set of G7 countries and the other group is non-G7 continental European countries. Although G7 countries are more coherent than non-G7 continental European countries in the bloc economy period, they are not in the second globalization era. The synchronization of cycles in the second globalization period is consistent with the proposition that the many kinds of policy harmonization or international leadership

¹⁰ Note that we have to equalize the number of countries in each group in the test and thus have to drop Denmark, another Scandinavian country.

initiatives promoted by G7 countries in recent decades have had positive spillover benefits outside the G-7 countries themselves.

In essence, the first globalization period never sees any coherent country groups based on race and language. However, the bloc economy period saw a big discrepancy between Anglo-Saxon group and other European country groups. This might be regarded as being driven by exclusive and biased trade and capital flows in the bloc economy as well as exclusive international political relationships. It is a bit surprising that the second globalization also sees some small coherent groups. This might be triggered by the solidarity through EU monetary systems and their own currency, i.e. Europeanization. However, importantly we have to mention that this result is fairly limited and not so general. Since only Tests 3 and 4 of Table 5 see significant results and other European country groups do not survive in other tests, we have to note that the Europeanization is limited and thus overwhelmed by globalization.¹¹

4. Conclusions

The paper set out to cast light on the relationship between business cycle transmission and globalization. Although globalization is usually statistically identified through the study of trade/output ratios buttressed by data on international financial relationships, a deeper understanding of the phenomenon and its consequences suggests that what is distinctive about globalization is that it implies that all countries affected participate in a global business cycle. This is the consequence of pervasive economic interrelationships.

In order to examine this proposition more closely we have drawn on the long run GDP data set assembled by Maddison as the basis for extracting the business cycle defined as a deviation cycle and identified by applying a Hodrick-Prescott filter to data for 19 developed countries. The cyclical deviates have been examined at first pass for their bilateral cross-correlations, dividing the sample into three sub-periods, the first (1870-1914) and last (1960-2004) corresponding to the two globalization “waves” commonly described in the literature, the third being the intervening period which contains two World Wars and the Great Depression. We term this period that

¹¹ See also Artis (2008) concerning how Europeanization is not so distinctive. He shows Globalization may be overwhelming Europeanization.

of the “bloc economy”. An examination of the distribution of the bilateral cross-correlations reveals that the average is highest for the second, then for the first globalization period, with that for the bloc economy rather lower; more marked perhaps is that the variance of the cross-correlations is biggest for the bloc economy period, which also displays a “twin peak” frequency, corresponding perhaps to the boost that some political arrangements gave to some groups of countries at the expense of others. Subsequently we applied a hard clustering analysis to the data. Here the most important finding is perhaps that the bloc economy period supports the best defined clusters of countries and the second globalization period the least well-defined. The first globalization period falls between the two or three, though it has much less clear split than in the bloc economy. This feature fits well with a picture of globalization that emphasizes the all-embracing nature of the phenomenon, leading to fewer, and less well delineated, sub-global clusters. Finally we applied the McNemar test statistic to the data, comparing the coherence of groups of countries with one another. Globalization should make it harder to find clear evidence of any difference in coherence between groups of countries, and this is what our data show.

Thus the analysis we have conducted so far appears to support well a proposition that says that globalization reduces the differences between countries in their business cycle experiences – and that this feature is more marked of the second (current) globalization era than the first. These results have been obtained using a well-trying empirical approach - namely the identification of trends in output and the extraction of a deviation cycle which permits the examination of synchronicity. Cluster analysis and the deployment of the McNemar statistic add some novelty to this approach in this particular application. The substance of the results confirms, rather than disturbs, what a priori speculation would lead us to believe. Of course there are many limitations that should be acknowledged. The data we use are annual in frequency, which inhibits precise dating of the cycle; we use business cycle synchronization as a short hand for business cycle transmission; and we ignore other dimensions of the business cycle experience (business cycle amplitudes and so forth) which might be relevant. Perhaps more seriously the low (only annual) frequency necessarily obscures the precise identification of cycle phases and impairs the separate identification of cycles from growth spurts. Even with data of this low frequency, though, it is possible that the results could be rendered more precise and reliable if we had recourse to wavelet analysis in the manner of Crowley (2007). This type of analysis

has been used in a related context by Crowley et al. (2006) in an elegant paper that examines the coherence of the EuroArea core in cyclical terms. The application of wavelet analysis in our context remains a task for a further paper.

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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. Our real GDP data are taken logarithmic form.

"Peak and Trough" binary data

To follow the type of tests proposed in Bovi (2005), we create "peak and trough" binary data. The binary data sets are derived from Maddison's real GDP data set. If the HP-filtered GDP cyclical deviate is positive in country i , the binary data for country i at time t are unity. The binary value of one stands for the peak. By contrast,

if the HP-filtered GDP is negative, the data for country i at time t are zero. Thus, the value of zero stands for the trough.

Countries distinguished in the study

See Table A for the country code and definition. We singled out nineteen major developed 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, and Japan.

Figure 1: GDP Cycles (First Globalization).

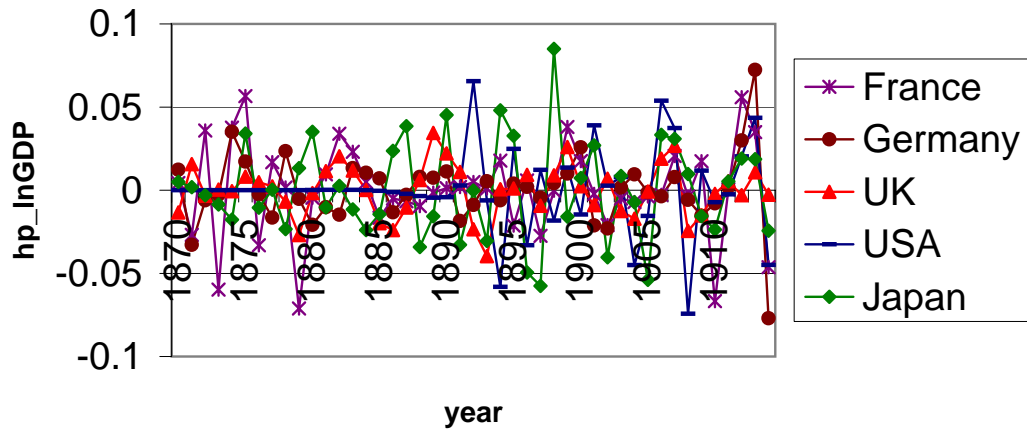


Figure 2: GDP Cycles (Bloc Economy).

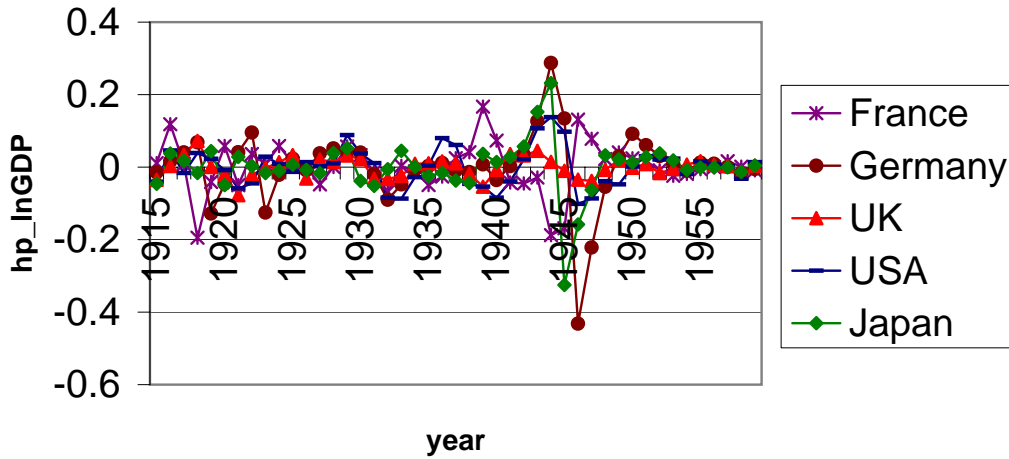


Figure 3: GDP Cycles (Second Globalization).

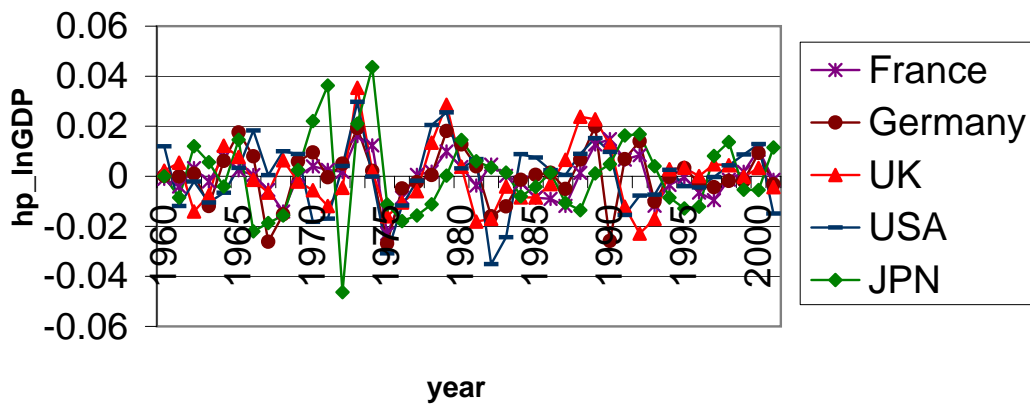


Figure 4: Cross-correlations (First Globalization).

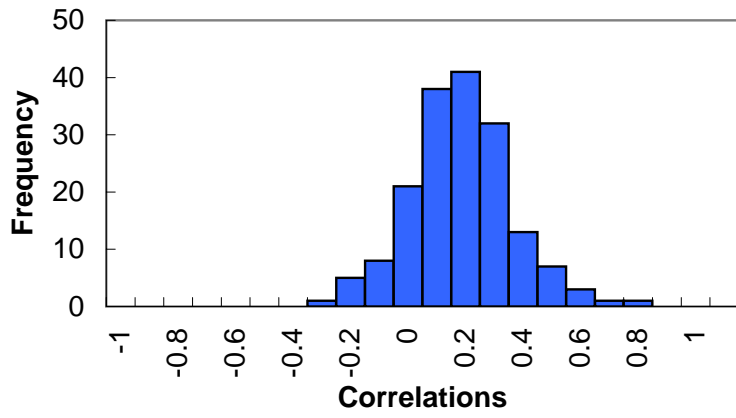


Figure 5: Cross-correlations (Bloc Economy).

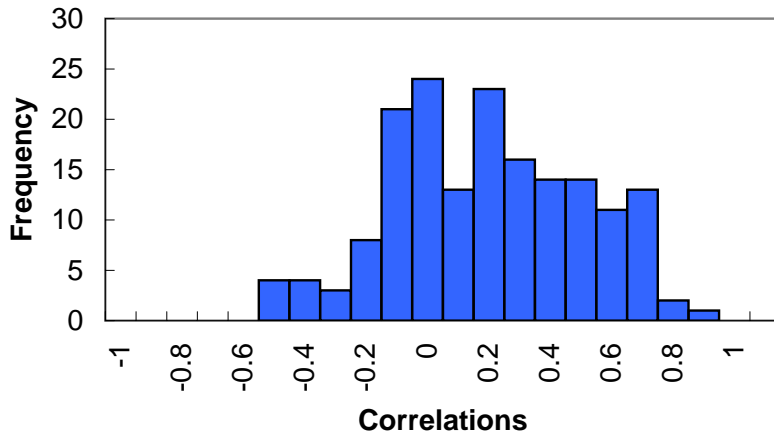


Figure 6: Cross-correlations (Second Globalization).

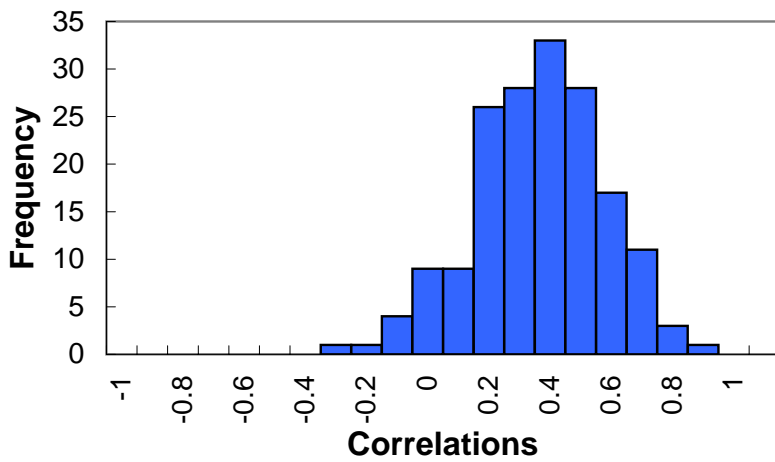


Figure 7: Cross-correlations.

First globalization (X-axis) and bloc economy (Y-axis)

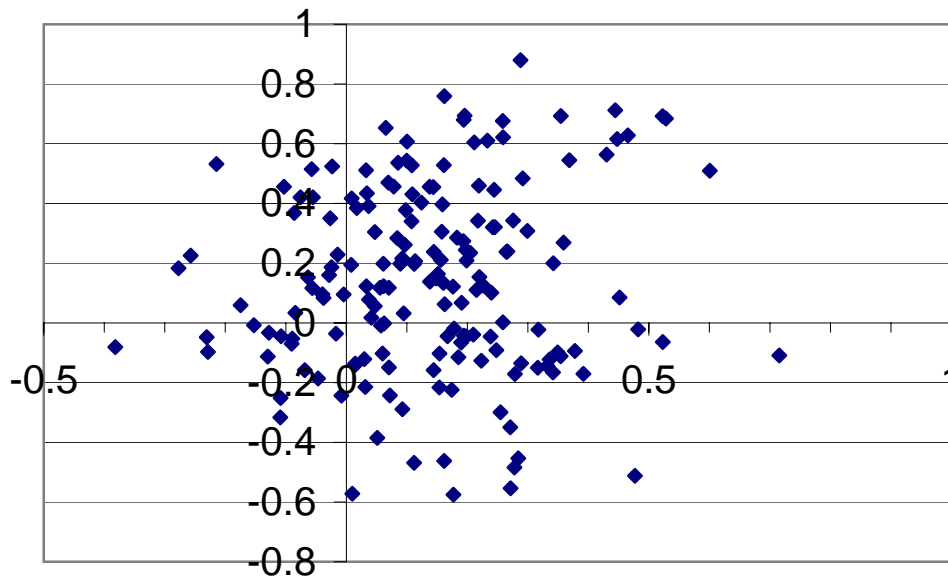


Figure 8: Cross-correlations.

Bloc economy(X-axis) and second globalization (Y-axis)

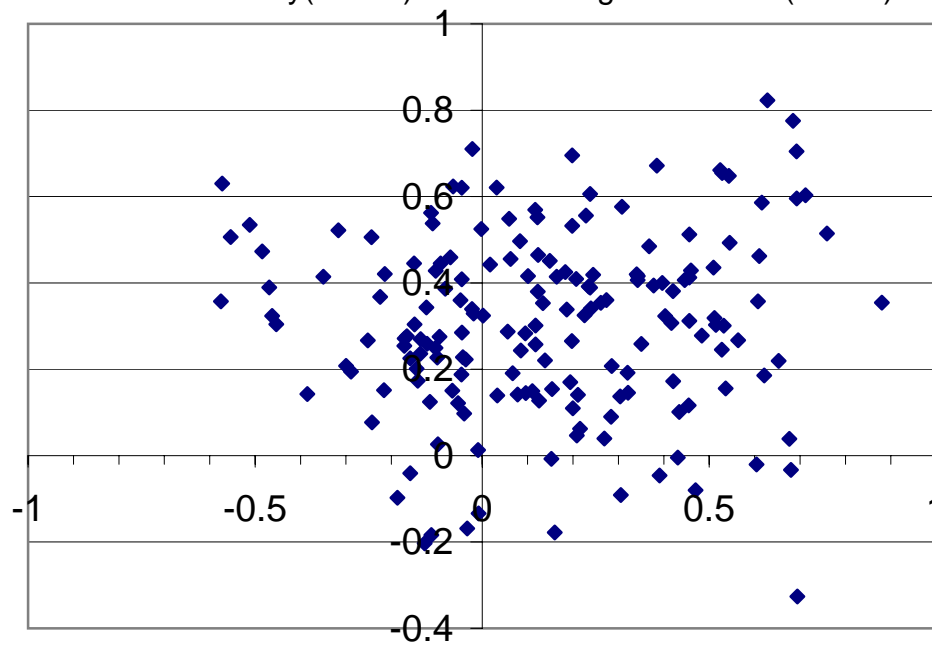


Figure 9: Cross-correlations.
First globalization (X-axis) and second globalization (Y-axis)

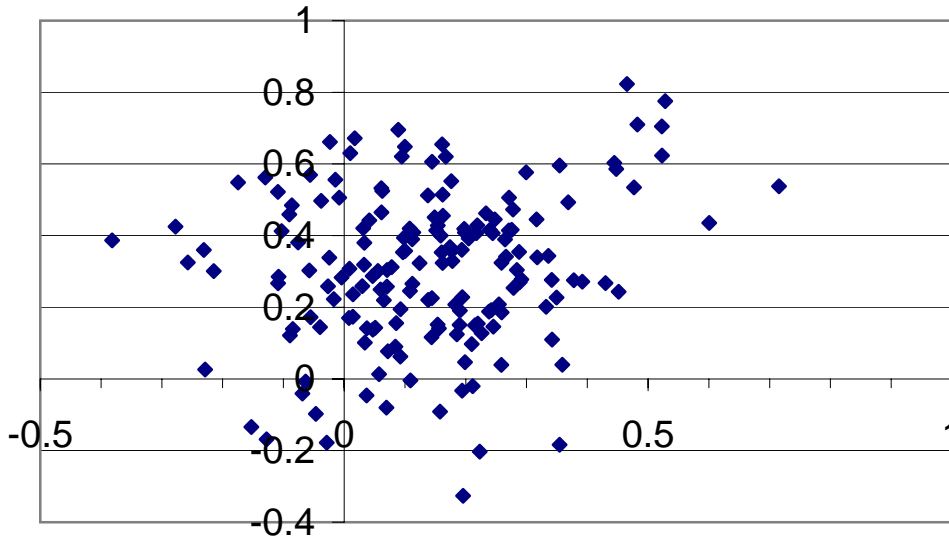


Figure 10: Dendrogram cluster analysis (the first globalization, 1890-).

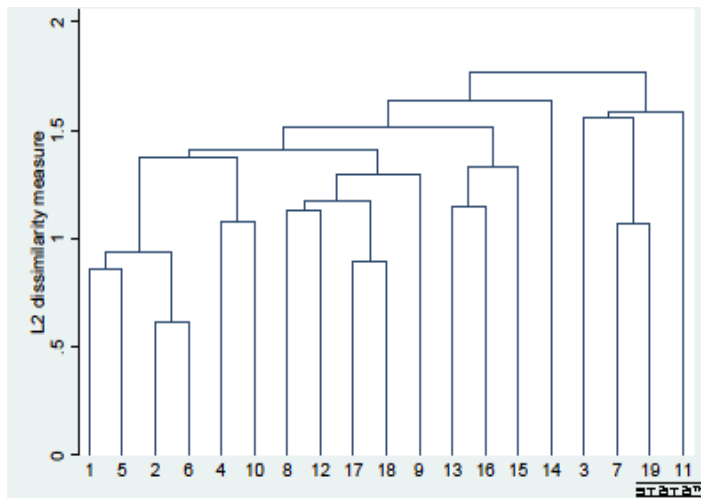


Figure 11: Dendrogram cluster analysis (bloc economy).

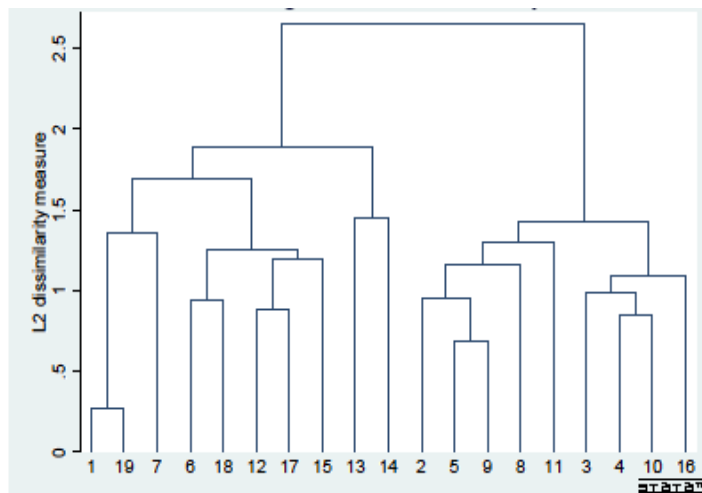


Figure 12: Dendrogram cluster analysis (the second globalization).

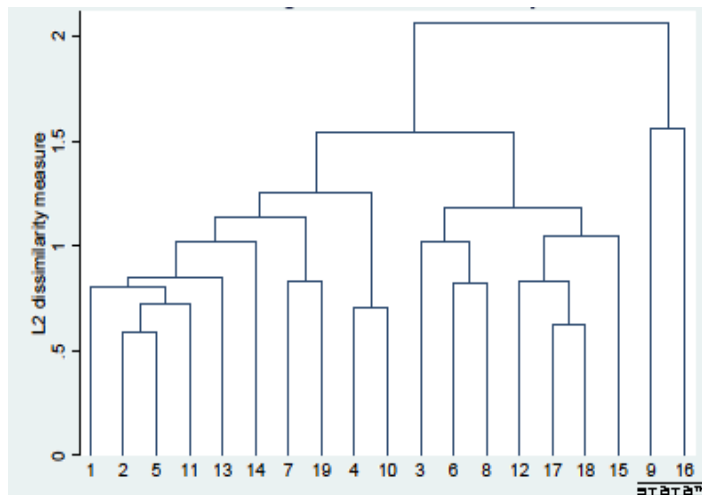


Table 1: H-P filtered GDP Cross-correlations in the First Globalization.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1																			
2	0.5228																		
3	-0.2573	0.0327																	
4	0.2049	0.3545	0.0856																
5	0.4823	0.5283	-0.0573	0.1376															
6	0.6006	0.7154	-0.1298	0.4515	0.4768														
7	0.1083	-0.0082	0.2384	0.2785	0.1974	0.0298													
8	0.2397	0.2993	-0.2774	0.1827	0.162	0.2713	-0.2146												
9	-0.0466	0.2113	-0.0862	0.0695	0.1956	0.0512	-0.0844	0.2591											
10	0.0469	0.4476	0.0652	0.5226	0.1004	0.3917	-0.1079	0.1588	0.2585										
11	0.0099	-0.0234	0.0373	-0.0145	0.0997	0.112	0.0314	0.1076	0.194	0.0783									
12	0.242	0.284	-0.1091	0.3165	0.271	0.0982	0.0087	0.3414	0.1538	0.336	0.0926								
13	0.0612	0.1445	0.0471	0.2176	0.0891	0.3175	0.1625	0.0556	-0.0286	0.2263	-0.0562	-0.0903							
14	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						
15	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					
16	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				
17	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			
18	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		
19	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	

Table 2: H-P filtered GDP Cross-correlations in the Bloc Economy.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	-0.064																	
3	0.2253	0.5114																
4	0.2346	0.6926	0.5361															
5	-0.0217	0.6845	0.5148	0.4561														
6	0.5094	-0.109	-0.1126	0.0852	-0.5119													
7	0.5277	-0.2436	-0.0458	-0.1713	0.2444	-0.1214												
8	0.1009	0.308	0.1831	0.2853	0.7594	-0.5539	0.5321											
9	-0.1865	0.6044	0.3679	0.4701	0.694	-0.3849	0.0334	0.6213										
10	0.0562	0.6158	0.653	0.6923	0.6073	-0.1706	-0.0447	0.3968	0.6763									
11	-0.5724	0.5241	0.0782	0.2284	0.5434	-0.4688	-0.2146	0.3402	0.68	0.4563								
12	0.3203	-0.4535	-0.3165	-0.1501	-0.3498	0.3775	0.4167	-0.1657	-0.2163	-0.1227	-0.2889							
13	0.1982	0.2376	0.3041	0.3424	0.1983	-0.0225	0.0624	0.1175	0.1599	0.1252	0.1168	-0.0701						
14	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					
15	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				
16	-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			
17	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		
18	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	
19	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

Table 3: H-P filtered GDP Cross-correlations in the Second Globalization.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	0.6233																	
3	0.3249	0.3189																
4	0.3919	0.5956	0.1557															
5	0.7103	0.7753	0.3027	0.5122														
6	0.4354	0.5377	0.5622	0.2433	0.5345													
7	0.2453	0.506	0.188	0.2541	0.4189	0.259												
8	0.4157	0.5765	0.425	0.2076	0.5145	0.5061	0.301											
9	-0.0976	-0.0204	0.4846	-0.08	-0.3262	0.1426	0.1393	0.1858										
10	0.2872	0.586	0.2194	0.7046	0.3574	0.2714	0.2851	0.4	0.0389									
11	0.6301	0.6613	0.1414	0.556	0.648	0.3896	0.4207	0.4198	-0.0329	0.3119								
12	0.192	0.3042	0.522	0.4453	0.4144	0.3938	0.3074	0.2764	0.1516	0.3432	0.1946							
13	0.5323	0.6058	0.1372	0.4067	0.6952	0.3395	0.4556	0.3014	-0.1778	0.1276	0.5692	0.4592						
14	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					
15	-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				
16	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			
17	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		
18	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	
19	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

Table 4: Cluster Analysis Stopping Rules.

First Globalization

Number of clusters	Pseudo-F	Pseudo T-squared
2	4.17	1.75
3	3.02	1.36
4	2.53	2.55
5	2.35	2.72
6	2.68	3.28
7	3.17	4.03

Bloc Economy

Number of clusters	Pseudo-F	Pseudo T-squared
2	22.08	3.07
3	14.34	5.53
4	13.28	/
5	10.52	4.33
6	11.13	33.89
7	10.35	1.94

Second Globalization

Number of clusters	Pseudo-F	Pseudo T-squared
2	5.49	/
3	3.45	9.59
4	6.74	3.56
5	6.59	3.04
6	6.59	3.24
7	6.9	2.35
8	6.62	2.12

Note: / denotes undefined.

Table 5: McNemar Test.

Test 1

	First	Bloc	Second
	0.043	6.533 **	0.474

Group 1 France, Germany, Italy
Group 2 US, UK, Canada

Test 2

	First	Bloc	Second
	0.429	5.538 **	0.059

Group 1 France, Germany, Netherlands
Group 2 US, UK, Canada

Test 3

	First	Bloc	Second
	0.000	1.000	10.286 ***

Group 1 Finland, Norway, Sweden
Group 2 US, UK, Canada

Test 4

	First	Bloc	Second
	0.000	0.286	3.769 *

Group 1 France, Germany, Italy, Belgium, Austria
Group 2 US, UK, Canada, NZ, Australia

Test 5

	First	Bloc	Second
	1.923	6.000 **	0.250

Group 1 US, UK, Germany, France, Japan, Canada, Italy
Group 2 Austria, Belgium, Denmark, Netherlands, Switzerland, Portugal, Spain

Test 6

	First	Bloc	Second
	0.200	4.167 **	0.889

Group 1 Germany, Italy, Austria
Group 2 US, UK, France

critical values Chi-square (1) at 10%=2.71, at 5%=3.84, and at 1%=6.63

***: 1% significance

**: 5% significance

*: 10% significance

Appendix Table A: The List of Countries Selected.

Code	Country
1	Austria
2	Bergium
3	Denmark
4	Finland
5	France
6	Germany
7	Italy
8	Netherland
9	Norway
10	Sweden
11	Switzerland
12	UK
13	Portugal
14	Spain
15	Australia
16	NewZealand
17	Canada
18	USA
19	Japan