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Has accession to the EU affected business cycles?

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Abstract. *This paper undertakes to explain the relationship between EU accession and the length of business cycles, focusing specifically on whether participation in a multinational organization has, or has not, altered the length of the cycle. Employing a sample of nine EU countries (Austria, Denmark, Finland, Greece, Ireland, Portugal, Spain, Sweden and the UK) we focused initially on annual data for per capita growth in GDP over a period of 59 years (1950-2008). For each country the sample was divided into two parts, one covering the period preceding accession to the EU and one is covering the accession year and succeeding years. Then, eliminating the background noise with the use of a periodogram, we proceeded to examine their spectral density plots. The results indicated that in the first years following accession, the countries tended to experience shorter cycles than they had previously. In the second phase the cycles were of the same duration as previous cycles. Finally, after a period of some years, the length of the cycles increased, as suggested by the J-shaped curve. This J-shaped growth curve applies for the countries that have joined the EU, strongly suggesting a causal relationship between accession to the EU and these specific characterristics of the curve. We cross-checked with a set of four non-EU member countries (Iceland, Norway, Switzerland and Turkey) and found no change in the length of the business cycle in these countries.*

Keywords: economic integration; business cycles; European Union.

JEL Codes: E32, F15, O11, O52.
REL Codes: 20B, 20G.

1. Introduction

A significant proportion of current literature on economic integration concerns itself with the question of whether there is any connection between the periodicity of business cycles in EU countries and the fact of their accession to the EU, and whether any relevant changes are to be included among the benefits of EU membership. Are any changes in the business cycle detectable in countries joining the EU? Have there been any major differences between the cycles in the case of countries joining the EU in the same period? Have changes to the length of the cycle, if there have been any, remained the same throughout the post-accession years? We have opted to conduct spectral analysis on what to our knowledge is the largest available sample and on that basis investigate the length of the business cycle in the countries that have come more recently into the European Union. This process is innovative, never having been applied previously to this field. This paper is structured as follows. In the first part there is an introduction to the basic questions and an explanation of the layout of the paper. The second part presents a survey of past work on the length of business cycles in EU and NAFTA member-countries. The third part gives a presentation of the methodology that has been selected. The fourth part examines the data and its transformations, along with an analysis of the spectrograms and their findings. Finally some conclusions are drawn and proposals made for further research in this field.

2. Previous references to EU and NAFTA

Recent work on the subject has emphasized the similarities in business patterns and attempted to provide an explanation for them. Bordo and Helbling (2003) examined three different methodologies and found that global shocks have had similar effects across all regimes throughout the 20th century, not just for the last thirty years, though in that period their influence has intensified. These two authors focus on the integration of money and international trade markets. Their treatment of capital controls seems inconclusive. The exchange rate regime does not play a crucial role in their findings.

Altavilla (2004) carried out a comparative analysis of the EMU countries, using a set of econometric techniques from convergence analysis and a Hamilton – Markov switching model to analyze the business cycle of Eurozone economies. The results suggested that there are some differences between the size and timing of business cycles in the different EMU countries, despite the many overall similarities, including the chronological coincidence of the main recessionary periods.

Bergman (2004) similarly studied the way that economic integration has affected the synchronization and the magnitude of business cycles in countries

participating in European Monetary Union. The conclusion from examination of bandpass-filtered data was that the cycles in question become more similar over time. It was found that cycles are highly synchronized, especially in a context of flexible exchange rates. According to Bergman there is a correlation between relative magnitude and the degree of synchronization in business cycles.

The foundation of NAFTA, a more recent integration undertaking than the EU, has also been more fruitful for securing the type of similarity over time that is to be seen in the European case. Benalal, Luis Diaz del Hoyo, Pierluigi and Vidalis (2006) have investigated the relationship between the change in the structure of GDP, its growth and synchronization of the business cycles of European countries. They concluded that there was no upward or downward trend during the 1970-2004 period, attributing this stability in the face of a diversity of counter-tendencies to demographics and to structural forms that have taken place in the past. Through the 1990s there was an increasing trend towards synchronization among these countries. The degree of correlation in annual and quarterly data appears to be at an all-time high. Kose M., Meredith G. and Towe C. (2004) admit that fluctuations in output now occur with greater synchronization. Countries tend to specialize their production in accordance with the relative competitive advantages each of them enjoys. The empirical findings of these writers corroborate theoretical assumptions concerning synchronization of business cycles. Their claim is that the correlations capture only the contemporaneous co-movements of macroeconomic variables and not fluctuations associated with leads and lags. Their chosen method for dealing with this problem was to utilize a latent factor dynamic model, sampling for which commenced at 1980 and ended at 2002 (22 years). The findings indicate that Mexico faced major competition from the other participating countries and had to reorient its production if it was to increase its exports within the zone. Mexico was thus forced to change in response to growth in intra-industry trade, barriers imposed by the regulatory framework and internal security concerns.

M. Cruz (2005) proposed a model derived from an amended version of that of Minsky in conjunction with the three-state switch regime business model proposed by M. Clements and H.-M. Krolzig (2001). Because business cycle stability is influenced by financial liberalization, when financial deregulation is launched, the length of the business cycle changes in the sense that the economy is likely to stay longer in the expansion phase, with shorter contraction and higher and sharper ups and downs. The years between 1980 and 2000 were a period of greater instability for Mexico than those preceding them, with the economy evidently more exposed. The business cycle was, and remains, shorter than in the developed NAFTA countries and the change has been in the direction of even shorter cycles.

3. Selection of methodology – proposal

Spectrum analysis is concerned with exploration of cyclical patterns of data. It seeks to break down a complex time series with cyclical components into a few underlying sinusoidal (sine and cosine) functions of particular wavelengths. Identification of the cyclical components enables us to find out something about the phenomenon. A successful analysis might make it possible for one to uncover just a few recurring cycles of different lengths in the time series of interest, which may at first have looked more or less like random noise.

The wave length of a sine or cosine function is typically expressed in terms of the number of cycles per unit time (frequency), denoted by f. The frequency in time terms may be monthly (N=12), yearly (N=1) or even weekly (N=52). The T period of a sine or cosine function is defined as the length of time required for completion of one full cycle. It is thus the reciprocal of the frequency, or: T = 1/f . The monthly cycle expressed in yearly terms would be equal to 1/12 = 0.0833. There is a period length of 0.0833 years.

The breakdown question is cast as a linear multiple regression problem, where the dependent variable is the observed time series, and the independent variables sine functions of all possible discrete frequencies. Such a linear multiple regression model might be written as:

$$x_t = a_0 + \sum \left[a_k \times \cos(\lambda_k \times t) + b_k \times \sin(\lambda_k \times t) \right] \ (\text{for } k = 1 \text{ to } q)$$

From classical harmonic analysis = $2 \times \pi \times f_k$, where the constant $\pi = 3.14$ and $f_k = \frac{k}{q}$. Cosine and sine parameters are regression coefficients that indicate the degree to which the respective functions are correlated with the data. There are q different cosine and sine functions. Obviously there cannot be more functions than data points in the series. If there are N data points in the series, there will be (N/2) + 1 cosine functions and (N/2)-1 sine functions. If a large correlation (cosine or sine coefficient) is identified, one may infer strong periodicity in the respective frequency or period in the data.

The sine and cosine functions are mutually independent, so it may be assumed that the squared coefficients for each frequency generate the periodogram. Its values come out as:

$$P_k = \left(\text{sine coef } f_k^2 + \text{cosine coef } f_k^2 \right) \times \frac{N}{2}$$

Where P_k the periodogram value at frequency f and N is the overall length of the series. The periodogram values can be interpreted in terms of the variability of the data at the respective frequency or period. Periodogram values are generally plotted against frequencies or periods.

Periodogram values are prone to substantial random fluctuation, with many chaotic spikes. Spectral density is simply a smoothed out version of the periodogram. It eliminates the noise from a periodogram, allowing the underlying structure to be more clearly isolated.

In practice, when analyzing actual data, it is crucial to achieve exact specification of the frequencies for particular sine or cosine functions. A smoothing out or adjustment can be effectuated via a weighted moving average transformation. The average moving window is of width *m* (which must be an odd number).

Most popular is the Tukey – Hanning window.(1) Its weights are:

$$W_k = 0.54D_p(2\pi f_k) + 0.25D_p\left(2\pi f_k + \frac{\pi}{p}\right) + 0.23D_p\left(2\pi f_k - \frac{\pi}{p}\right),$$

where: k = 0, ..., p.

P is the integer part of the number of spans, divided by 2. D_p is a Diriclet kernel of order *p*.

4. Data set and results

Within this framework we have chosen to test whether the cycles have increased or diminished since the end of World War II and EU integration and whether they follow a pattern, using the spectral analysis as a tool for the first time in the field. We selected a sample of nine EU countries (Austria, Denmark, Finland, Greece, Ireland, Portugal, Spain, Sweden and the UK) and a second one of four countries (Iceland, Norway, Switzerland and Turkey) that are non-EU members. The series for per capita GDP is of course non-stationary, so to check the length of the business cycles we used for each country the annual data over a period of 59 years (1950-2008) for per capita growth in GDP, this being the largest sample ever deployed in integration studies. For each of the EU member-countries the sample was divided into two parts: one covers the period preceding accession to the EU and one covering the accession year and succeeding years. For the others the dividing line was drawn in 1973, the year of Denmark's, Ireland's and the UK's accession to the EU. The database employed was the Total Economy Database of the Conference Board and Groningen Growth and Development Centre as it was at the time of the January 2009 report. We also had also quarterly data for all these countries, but when we checked on its ability to find periodicity we discovered that it was overlapped by series noise.

For this analysis we used the SPSS™ statistical software, including its spectral analysis tool, with Tukey – Hanning weighting and with span 3 the closest odd integer higher than the smallest period (one year for this sample). We plotted spectrograms based on period, the results of which are presented in the table below.

Table 1

Spectral density results for EU countries

Country	Year of access	***f before*** EU (years)	***f*** after EU (years)
Austria	1995	6.75	4.5
Denmark	1973	5.5	10.8
Finland	1995	13.5	4
Greece	1981	8	8
Ireland	1973	5.5	10.8
Portugal	1986	10.8	8.1
Spain	1986	10.8	8.1
Sweden	1995	13.5	4
UK	1973	5.5	13.5

The results show that countries joining the EU at an early date present increases in periodicity over the preceding period. The cycle for Greece is the same as it was before and countries that have joined more recently have shorter cycles. Increasing periodicity is definitely preferable from the viewpoint of economic stability, as the economic shocks are rarer and smaller and it is easier to defend one from them. The recessions of 2008 and 2009 were by-products of Kondratiev-type long waves. The composition of output has moved away from manufacturing to less cyclical sectors such as services and the e-economy. The increased stability in individual sectors – and in the economy as a whole – is obvious.

All countries with the exception of Finland and Ireland in the early years of the study had larger growth periods within their cycle, with higher peaks and spikes than in the later years after the onset of economic integration. During this same early period Finland had lower peaks than in the later years following acession. The cycles for Ireland in the early stage followed the pattern for their counterparts but after the subsequent surprising technological developments the market boom in Ireland was followed by a major decline towards the end of the first decade of the 21st century, when Ireland went into an extremely sharp depression.

The question raised by these results is whether the countries with longer cycles than before used to have shorter cycles or cycles of equal length in the early years following accession, and if so how long this situation persisted. We checked this by constructing successive data sets for the early-entry countries so as to examine whether these countries had gone through an earlier stage during which business cycles were shorter than in the period prior to entry into the EU. We selected seven spectrograms from the four countries (Denmark, Ireland, and the UK for two periods, including the last year, where the cycles were shorter than or equal to what they had been prior to accession, and one for Greece from the last year that periodicity was smaller). The results are shown in the following table:

Table 2

Smaller and Equal cycles for EU-accession countries

Country	*f* ***before*** EU	Year of access	*f* of smaller cycle	Last year of smaller cycle	Years from accession to smaller cycle	Last year of equal cycle	Years from accession to equal cycle
Denmark	5.5	1973	2.75	1990	17	1994	21
Ireland	5.5	1973	4.6	1988	15	1997	24
UK	5.5	1973	4.8	1991	18	1994	21
Greece	8	1981	6.8	2005	24		

The results shown on the second table indicate that the three early-entry countries passed through an initial 15-to-18 year phase where the cycles were shorter than in the period prior to accession. Greece had a shorter 24-year cycle until 2005, the same as in the period preceding accession. The era that then began for the four countries was one of equal cycles. The equal cycles for Denmark and the UK in 1994, 21 years after conclusion of the accession process, were followed by an equal- cycle period for Ireland three years later, and then a longer cycle period. The conclusion is that the countries with longer present-day cycles went through a period early in the accession process where periodicity was lower than it had been prior to accession – something similar to what is observable today in later-entry countries – followed by a cycle period of equal length, similar to what Greece now experiences.

That amounts to a J curve effect for the length of the business cycle against time. In the first phase the country hasn't yet come into the EU. Its business cycle at this point is taken as the point of reference. In phase 2 or early access the cycle becomes ever shorter than the initial cycle until it bottoms out. The length of the cycle increases in phase 3 until it regains the periodicity it had at the outset. In the final phase the business cycle is longer than prior to integration into a multinational schema.

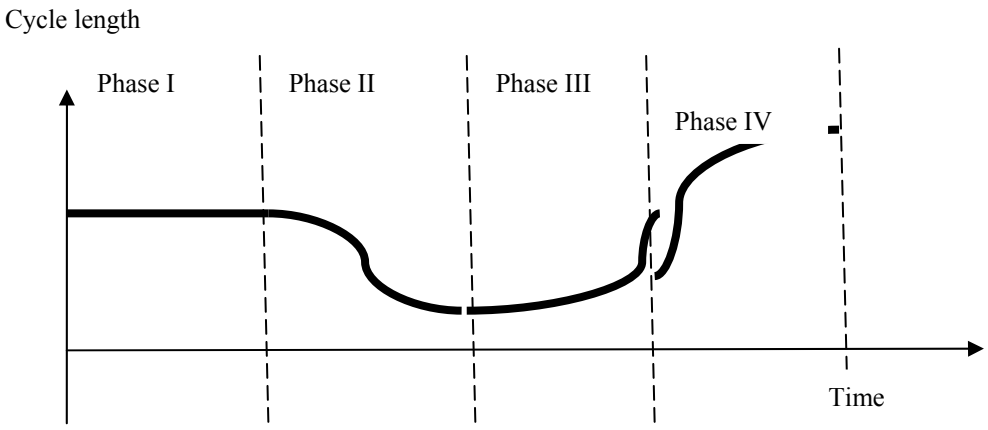

Figure 1. *The J curve of the business cycle*

This J pattern can be explained in number of different ways. The production orientation of the new members is not altogether clear in the primary stages. The priorities change, leading to specialization in production, because the countries can now more easily than before import cheaper and more sophisticated technology through the mechanisms of economic union. Traditional industries in these countries close because of the more intensive competition. Financing through EU subsidies cannot have the required effectiveness because of insufficient experience in handling it. The whole economic infrastructure has to change to meet the Union's standards. Countries transfer resources from agriculture and raw material production to the manufacturing sector, where cycles tend to be shorter and prices more volatile. Investment in technology from abroad has considerable impact on the trade balance of the recipient county, raising its deficit.

Owing to inconclusiveness over the likely future course of the economy, there can be no full programming of the production process. It is still under review in what domains the country will choose to specialize, introducing an element of randomness into the country's developmental course. In this first stage (Phase 1) the country's orientation is not particularly clear.

All the economic turbulence that has resulted in shorter business cycles comes to an end when the economy finds its place in the structures of the Union. The Basic Balance deficits fall and the economy enters a phase of intensive development on the basis of the investments and infrastructure inherited from the early years (Phase II).

In the third phase the economy regains its equilibrium, with the length of the business cycles equal to those of the period preceding entry. The adjustment problems occasioned by accession to the Union have been overcome and membership can now begin to deliver benefits and underwrite stability.

In the fourth and final phase, with the first years of participation now in the past, membership of the Union has become profitable. Specialization has had the effect of fostering a strong and smooth-functioning economy based on successful long-term investment. The country's business cycles are therefore now longer and more regular than before.

It could be argued that the business cycle has changed a result of changes in economic orientation or of the fact that cycles have tended to be longer since World War II or that the periodicity of services is different from that of products. We would then have to compare the business cycles of countries that had entered the EU with those that had not succeeded in fulfilling its demands or did not want to be a part of it. We accordingly checked the same indicator (GDP per capita growth) over the same period (1950-2008) for four countries (Iceland, Norway, Switzerland and Turkey). These were countries that did not

intend to participate in initiatives for regional integration, had not undergone any major political or economic transformation within the period under examination and had a level of development approximating that of the countries that had joined the EU in the past. The question that arose was that of the turning point around which the sample should be divided as a basis for comparison. We chose to insert the break at the year 1973, when the early joiners entered. If by chance there was an overall increase in the cycles at that time, the implication would be that the non-member countries must have undergone the same change. If they did not, the J curve apply would apply for member countries only. The results of the analysis are set out in Table 3.

Table 3

Non EU members cycles length

Country	*f* before 1973	*f* after 1973
Iceland	8.1	8.1
Norway	8.1	8.1
Turkey	8.1	5
Switzerland	8.1	8.1

As we can see, in relation to the same period the three non-members have maintained the periodicity of the cycle and one non-member (Turkey) has reduced its cycle from 8.1 to 5 years. It can be inferred from these results that the J curve with the business cycle is something that applies for EU members.

5. Conclusions and proposals for further research

Spectral analysis indicates that for an initial period which can be from 15 to 24 years, countries tend to have shorter cycles than they had prior to accession. Then, according to the data, for a brief period of four to nine years, they regain their prior level and later raise the length of their business cycles. There are major advantages to a company being inflicted with milder, shorter and rarer shocks to the economy in the recession phase of the cycle. The economic environment of the post-World War II era has helped countries to develop through economic integration schemes such as the EU, unquestionably helping them to place their economies on a stabilizing path. The question that must be answered in the course of any analogous work of the future is whether countries with smaller or equal cycles (in the period since 1986) will follow the J curve. But to answer this would take some time and is doubtless a long-term task for the future.

The J-curve effect introduced in this work can be seen among EU members. The cycles of non-participating countries have been maintained at the same levels or reduced. Expanding the range of research, it is possible to examine countries

from other economic unions with a view to detecting possible J-curve effects, and the terms of reference could even be extended and elaborated in pursuit of a macroeconomic explanation for the recession, even if this means including factors not related to growth in the strict sense. The analysis attempted here has sought to focus on supranational economic unions and the length of cycles.

The current systemic crisis began in 2008 and in its repercussions is comparable only to the great recession of the 1930s. The decline, especially for newer members of the European Union (those joining in 2003 or after), has been rapid. The more developed members are not likely to be so seriously affected by the consequences of the recession and, to judge from 2009 data, will not see significant changes to the pattern of their cycles. Given successful implementation of their governments' European policies, 2010 could for them even be a year of expansion.

Note

(1) As one approaches the end of the series, adjustment is accomplished via reflection. If the span is 5, then the second spectrogram is adjusted by averaging the first, third and fourth values and twice the second value. See Priestley M. B. 1981.

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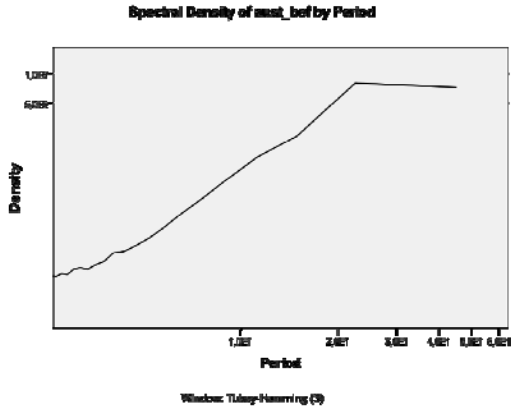
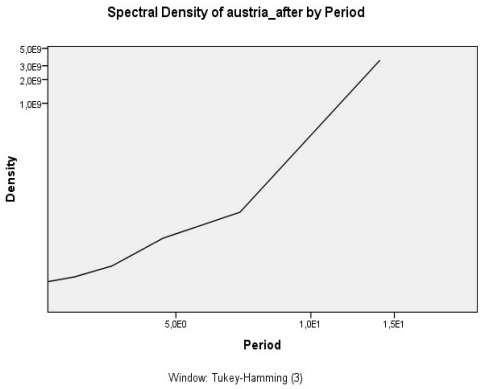
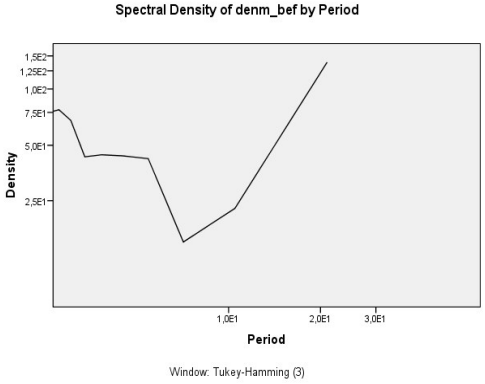
Appendix: Spectrograms



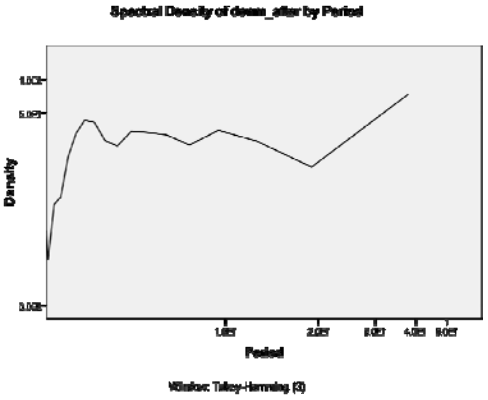
plot 1: Austria 1950-1994



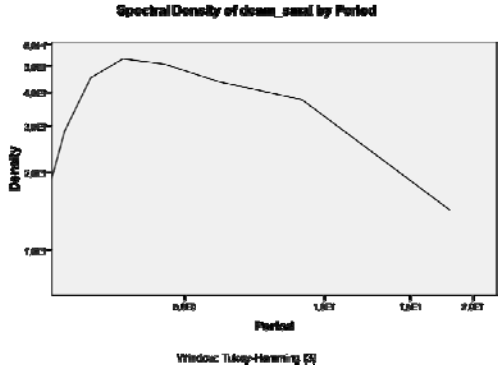
plot 2: austria 1995-2008

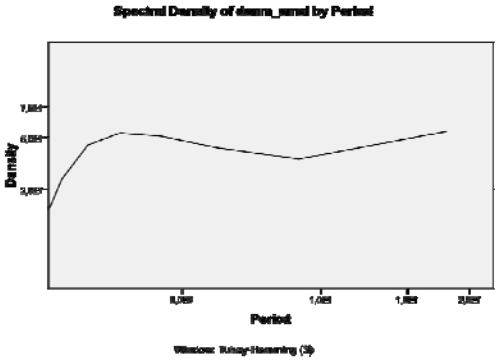


plot 3: Denmark 1950-1972

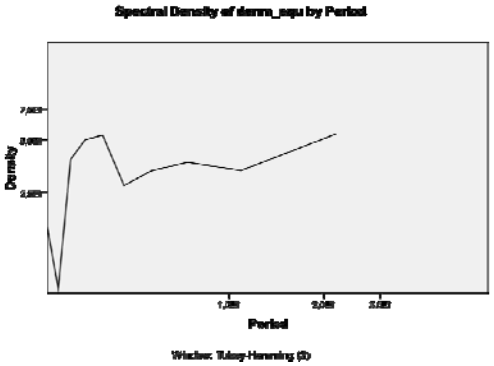


plot 4: Denmark 1973-2008

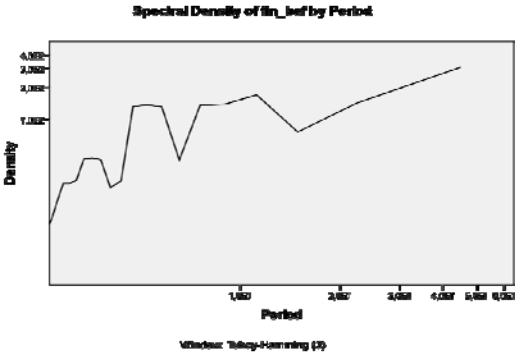




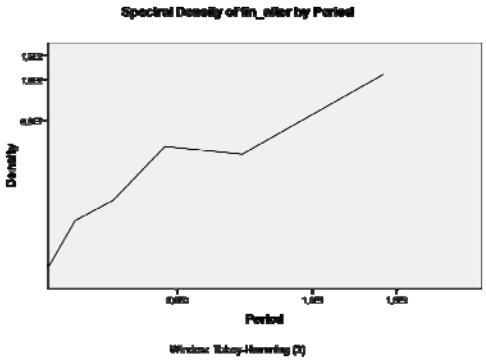
plot 5: Denmark 1973-1990



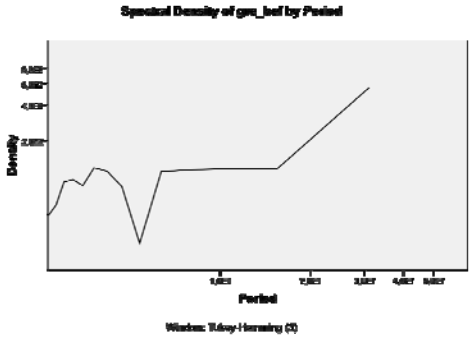
plot 6: Denmark 1973-1994



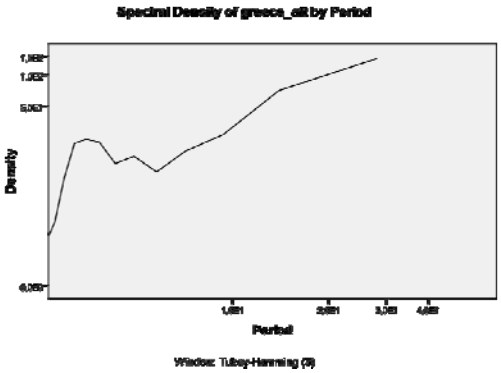
plot 7: Finland 1950-1994



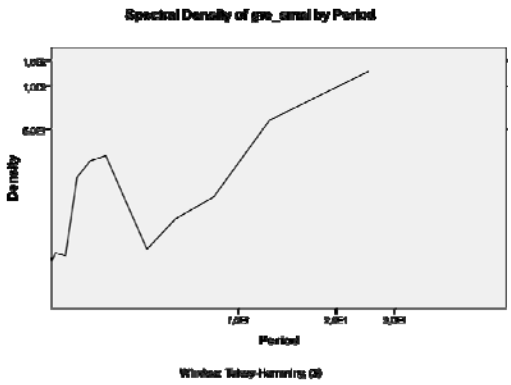
plot 8: 1995-2008



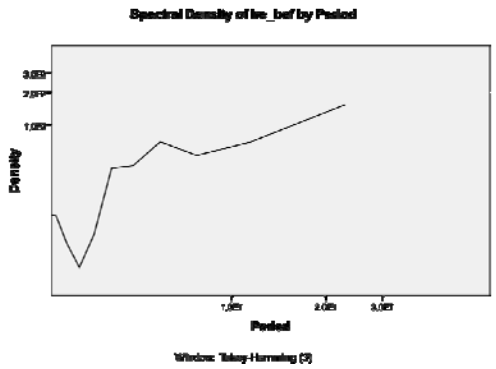
plot 9: Greece 1950-1980



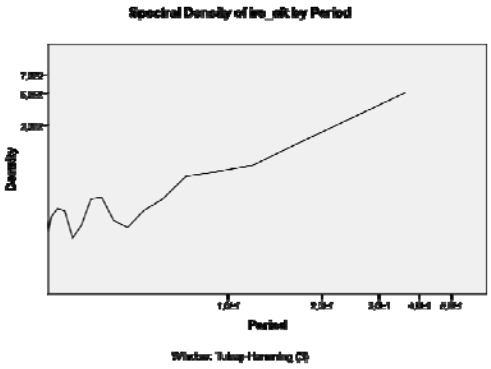
plot 10: Greece 1981-2008



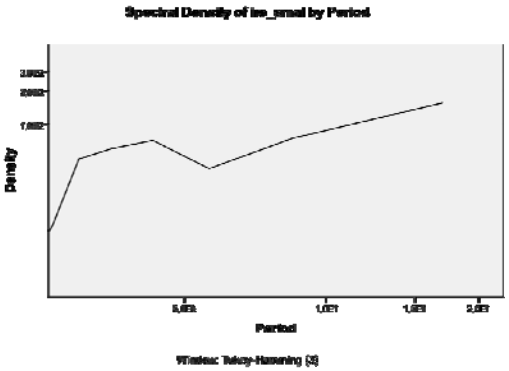
plot 11: Greece 1981-2005



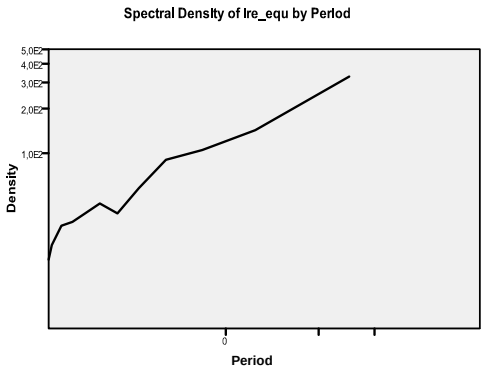
plot 12: Ireland 1950-1972



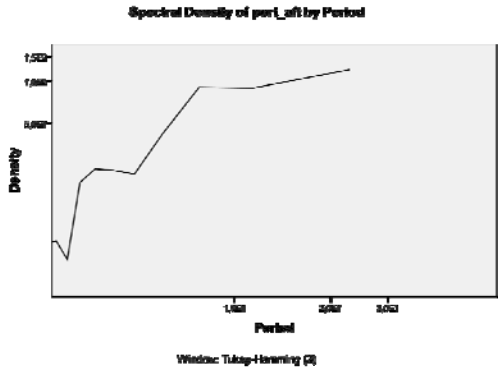
plot 13: Ireland 1973-2008



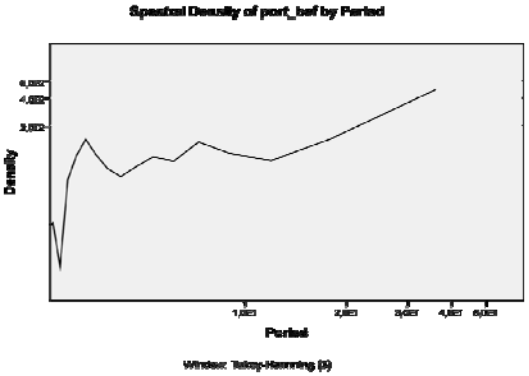
plot 14: Ireland 1973-1988



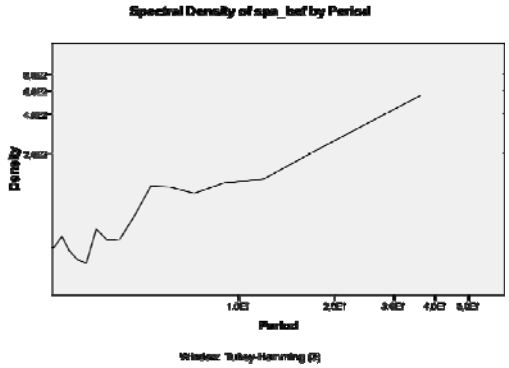
15: Ireland 1973-1997



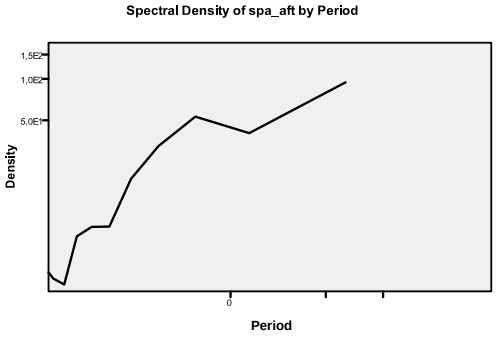
plot 16: Portugal 1950-1985



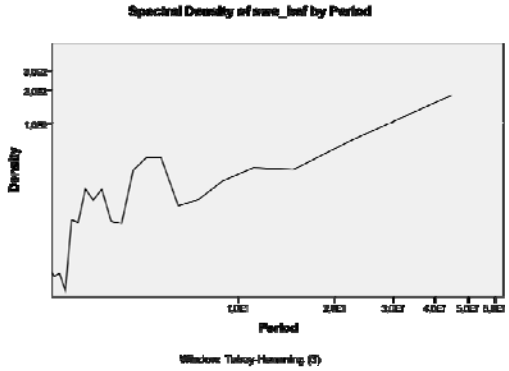
plot 17: 1986-2008



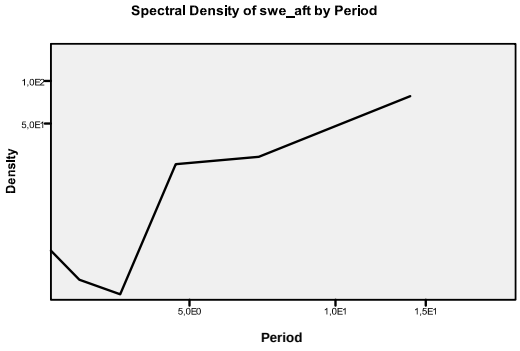
plot 18: Spain 1950-1985



19: Spain 1986-2008

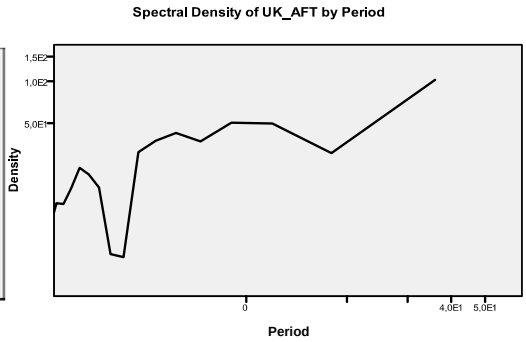


plot 20: Sweden 1950-1994

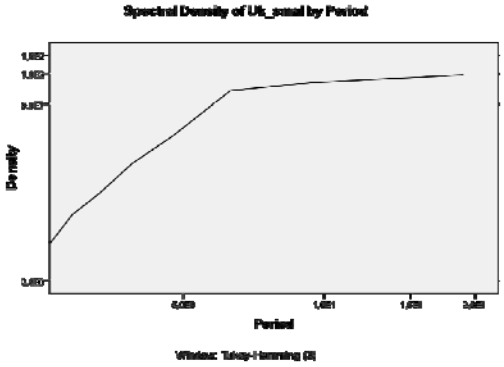


21: Sweden 1995-2008

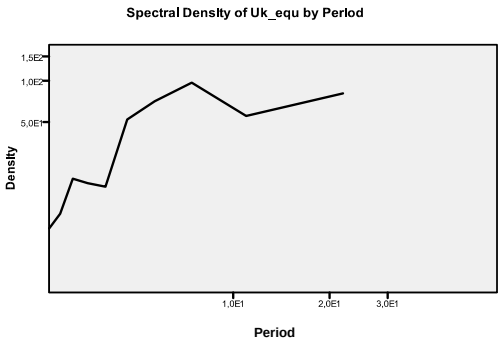
plot 22: UK 1950-1972



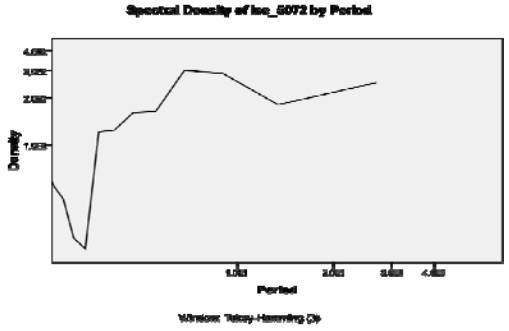
23: UK 1973-2008



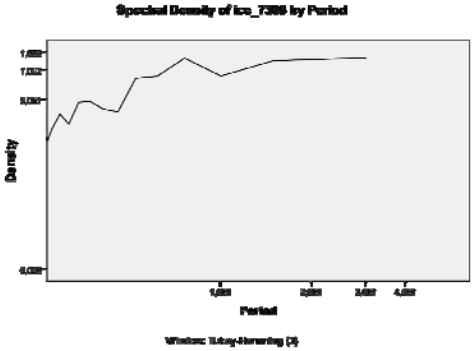
plot 24: UK 1973-1991



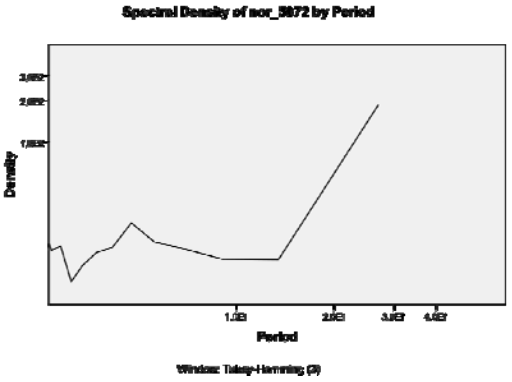
25: UK 1973-1994



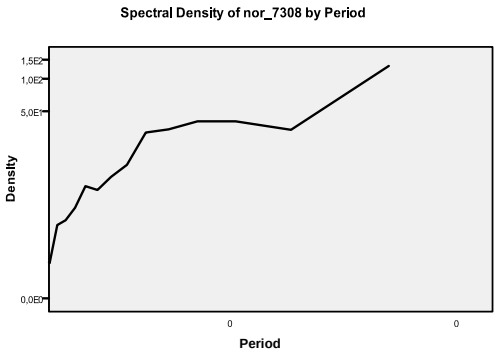
plot 26: Iceland 1950-1972



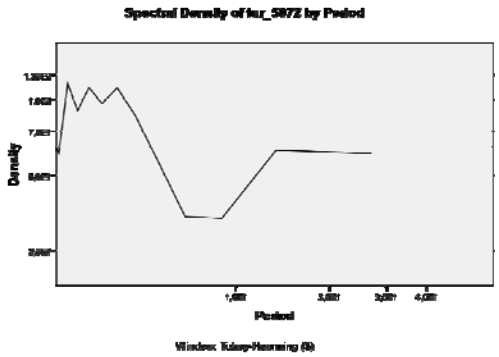
plot 27: Iceland 1973-2008



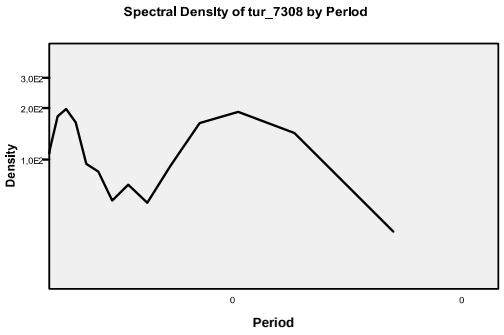
plot 28: Norway 1950-1973



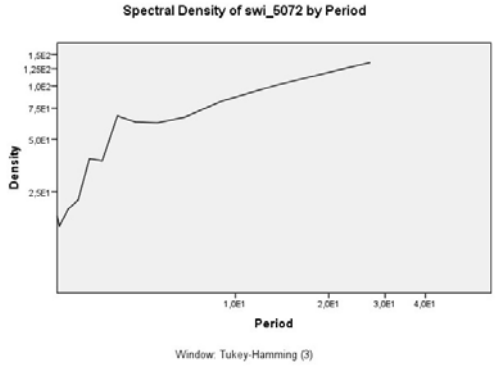
plot 29: Norway 1973-2008



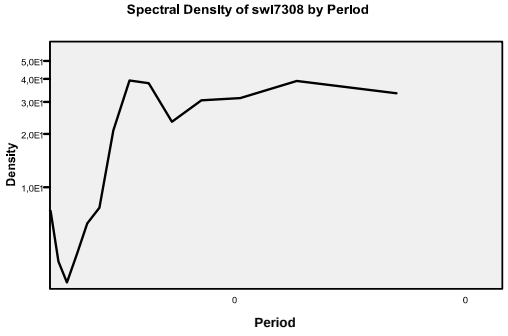
plot 30: Turkey 1950-1972



31: turkey 1973-2008



plot 32: Switzerland 1950-1972



plot 33: Switzerland 1973-2008