HAS THE NAFTA FOUNDATION AFFECTED BUSINESS CYCLES LENGTH? AN INTRODUCTION

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Abstract

This paper is explaining the relationship between NAFTA foundation and business cycles length. Has the participation in a multinational organization changed their frequency? Initially; we used GDP per capita growth annual data for each country countries (Canada, Mexico and USA) for 63 years (1950-2012). The data was cut for each country in two pieces one before the 1995 and one on the year of integration and after. Then we selected their spectral density plots in order to find periodicity eliminating the background noise from a periodogram. The results show that Canada doubled its cycle length progressively. Mexico and USA seem to have currently smaller but growing cycles than they used to have.

1. INTRODUCTION

A major part of economic integration literature is investigating if the periodicity of business cycles in EU countries has to do with the accession and its benefits. Enlarging and coordinating the business cycle has major advantages for the participating country in the international organization. Through integration country can gain economic, political and social stability the larger and smoother cycle long term introduced. Additionally, coordination has the advantage of common remedy for the coordinated countries as happened in the recent EU countries debt crisis. Has the business cycle changed the years following the union access? This is also an interesting question because if the cycles seem to enlarge then the integration is successful if not is a failure and it must be revised. Were there any major differences among the cycles for countries founded the NAFTA simultaneously? If some countries failed to coordinate then the union works for the others and they were unsuccessful. Finally, the length of the cycle has been affected the same way all the years

after the accession? If the cycle length had increased but later decreased the integration effects were temporary and new better working schemes should be implemented. Concluding, the question whether the business cycles of the EU countries have been increased has to do with the existence, the prosperity and the economic, social and political stability of these countries and the union in the future. We have chosen to deploy the largest sample used according to our knowledge (63 years from 1950 to 2012 respectively). The current paper is structured as follows: On the first part there is an introduction on the basic questions and the paper structure. The results of economic integration process the importance and significance of business cycle analysis and the previous studies are analyzed to the second part. The methodology, the data used its link to the questions and its transformation is presented on the third part as long and as long as the analysis of the spectrograms and the results. On the final part we present our conclusions and propositions of further research on the field.

2. BUSINESS CYCLES IMPORTANCE AND PREVIOUS STUDIES

The significance of business cycles length analysis is crucial for the economic integration process. A country will decide to join an economic union or organization based on long term economic, political and social benefit. The larger business cycles offer stability against international economic fluctuations such as happened on the 2008 to present global economic crisis, add political confidence and raise social and economic prosperity and welfare in the participating country.

Spectral analysis was especially developed on Kondratieff cycles (Van Ewijk, 1982) where long term cycles for the industrial countries have been analyzed. The econometric expression which became traditional (Kydland and Prescott, 1991) where technological shocks and the growth models were quantified due to the econometrics explosion during this period. The major question since NAFTA foundation has to do with the integration effects to the weakest link of the union the economy of Mexico. The tequila crisis in 1994 caused a sharp devaluation of peso and development decline didn't have any major effects on the other participating countries. The boost of international trade among the countries helped the economic development among them in the 90s and 00's until the global crisis on the end of the decade. On the case of Mexico (Reyes, 2003) studied on traditional approach established a common basis for comparing results to different countries. Among other results he concluded that the internal components effects were extremely high during the 1980's. Closing 20th century fluctuations a later work (Bordo and Helbling, 2003) checked three different methodologies. They found that global shocks have similar influence across all regimes for all the 20th century and not only for the last thirty years though their effects have been increased. They focus on the integration of money and international trade markets, and capital controls seem inconclusive. The exchange rate regime doesn't have a crucial role in their findings. Their cyclical effect has to be examined and determined. Others (Kose *et al,* 2004) admit that financial linkages have higher degree of synchronization of output fluctuations. The countries tend to specialize their production based on competitive advantages of each country. Their empirical findings have proven these theoretical assumptions and the business cycles seem to synchronize. They claimed that the correlations capture only the contemporaneous comovements of macroeconomic variables and not fluctuations associated with leads and lags. To overcome these problems they choose a latent factor dynamic model. Their sample begun in 1980 and end in 2002 (22

years). The results show that Mexico faced major competition from the other participating countries and it had to adjust its production orientation whether the increase in exports within zone. Thus Mexico has to change in order to face the intra-industry trade growth, the regulatory framework barriers and the security issues within the country.

Proposing an amended version of Minsky's model (Cruz, 2005) integrated with the three states business model of switch regime model proposed (Clements and Krolzig, 2001), financial liberization influences the business cycle stability. Thus when the financial deregulation strategy launches the business cycle length changes in the sense that the economy is likely to last longer in the expansion phase and contractions may be shorter and downs or ups higher and sharper. The years 1980-2000 for Mexico were more unstable than the past and the economy seem more exposed. The length of the business cycle is shorter than the developed countries of NAFTA and it has been altered to smaller cycles.

Similar studies were also published for the EU integration. The case of EMU countries comparison has been analyzed (Altavilla, 2004). Using a set of econometric techniques of convergence analysis and a Hamilton –Markov switching model is used to analyze Euro area economies business cycle. The results suggest that there are some differences in the EMU countries cycles size and timing despite the similar pattern and the common main recessionary periods.

On the same subject (Bergman, 2004) has studied the way that economic integration has affected the synchronization and the magnitude of business cycles among the participating countries. Based on bandpass filtered data they conclude that they become more similar over time. They found that cycles are highly synchronized especially on high flexible exchange rates periods. More synchronization according to Bergman has larger relative magnitude.

Investigating the relationship between the change of the GDP structure and its growth and the synchronization of the European countries business cycles (Benalal *et al,* 2006) concluded that there is no upward or downward trend during the 1970-2004 period. They have reasoned this stability to different trends to demographics and to structural reforms that taken place in the past. The trend of synchronizing among the countries has risen over the 1990's. The degree of correlation in annual and quarterly data seems to be at a historical high.

EU integration studied (Filis *et al.* 2010) paper based on business cycles synchronization between EU and Bulgaria. They take a sample of 77 quarters and they present the country's target to join EMU in the future. Dynamic elements in their model are not present as comparison is done on the same quarter without using possible lags. The research target is to check whether the two cycle patterns are joined especially on stochastic shocks. Their results show that the two samples as the series runs reduce deviation   and follow the same pattern by the end of the sample

In a recent study (Evangelopoulos and Dapontas, 2013) for the EU participation business cycles, the authors compared the business cycles for 9 EU countries[1] and 4 non EU members[2] for 59 years (1950-2009). The results show that the countries the first years of accession tend to have smaller cycles than they used to have varying from 15 to 24 years. On the second phase the cycles had the same duration with the ones before. Finally, the cycle length after an amount of years rises up forming a J shaped curve. The J growth curve refers to EU accessed countries thus it's an effect of the access. They checked a set of four non EU member countries the results show that the cycle on the same period for these countries didn't change. The countries reached their previous cycles length in a 20-25 years

period. Earlier accessed countries were less prone to the current global economic crunch than their followers or non-members.

3. DATA SET AND RESULTS

Spectrum analysis is concerned with the exploration of cyclical patterns of data, the purpose of the analysis is to decompose a complex time series with cyclical components into a few underlying sinusoidal (sine and cosine) functions of particular wavelengths. By identifying cyclical components, we will learn something about the phenomenon. As a result of successful analysis one might uncover just a few recurring cycles of different lengths in the time series of interest, which at first looked more or less like random noise.

We have chosen Singular Spectrum Analysis (SSA) because according to references (Sella, 2008) the method works well even with mildly non- linear data, is an innovative flexible data-adaptive method allowing spectral decomposition even if the series is short and noisy. Moreover SSA allows inspecting the series in various resolutions. Other references (Pollock, 2008 and Neftci, 1984, Brock and Sayers, 1988, Frank and Stengos, 1988, Serletis, 1996, Altissimo and Violante 1998) declare that a clear understanding of business cycles can be achieved only in the lights of spectral analysis.

The wave length of a sine or cosine function is typically expressed in terms of the number of cycles per unit time (frequency), denoted with f. The frequency in time terms for example yearly, may be monthly (N=12), annual (N=1) or even weekly (N=52). The period T of a sine or cosine function is defined as the length of time required for one full cycle. Thus, it is 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 decomposing issue is casted as a linear multiple regression problem, where the dependent variable is the observed time series, and the independent variables are sine functions of all possible discrete frequencies. Such a linear multiple regression model may be written as:

$$x_t = a_0 + \sum [a_k * \cos(\lambda_k * t) + b_k * \sin(\lambda_k * t)] \ (for\ k = 1\ to\ q)$$

From classical harmonic analysis $= 2 * \pi * f_k$, where the constant $\pi = 3.1\overline{4}$ and $f_k = \frac{k}{q}$. Cosine and sine parameters are regression coefficients that tell us the degree to which the respective functions are correlated with the data. There are q different cosine and sine functions. It's obvious that there can't be more functions than data points in the series. There are N data points in the series, there will be $(N/2) + 1$ cosine functions and (N/2)-1 sine functions. If there is a large correlation (cosine or sine coefficient) is identified, one can conclude that there is a strong periodicity of the respective frequency or period in the data.

The sine and cosine functions are mutually independent, thus we sum that the squared coefficients for each frequency obtain the periodogram. Its values computed as:

$$P_k = (sine\ coeff_k^2 + cosine\ coeff_k^2) * \frac{N}{2}$$

Where P_k is the periodogram value at frequency f and N is the overall length of the series. The periodogram values can be interpreted in terms of variance of the data at the

respective frequency or period. The periodogram values are generally plotted against the frequencies or periods.

The periodogram values are subject to substantial random fluctuation, and they have many chaotic spikes. Spectral density is simply a smoothed 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 identify exactly the frequencies for particular sine or cosine functions. The smoothing can be accomplished via a weighted moving average transformation. The moving average window is of width *m* (which must be an odd number).

The most popular is the Tukey – Hanning window[3]. Its weights are:

$$W_k = 0.54 D_p (2\pi f_k) + 0.25 D_p (2\pi f_k + \tfrac{\pi}{p}) + 0.23 D_p (2\pi f_k - \tfrac{\pi}{p}) \text{ where } k=0...p.$$

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

We have also checked whether the series are normally distributed. We used the Jarque-Bera test for normality which measures the difference of the skewness (*S*) and Kurtosis (*K*) of the series with those from the normal distribution. The statistic is computed as:

$$\text{Jarque-Bera} = \frac{N}{6}\left(S^2 + \frac{(K-3)^2}{4} \right)$$

Additionally, we have checked for autocorellation which is critical because the only variable we have is autocorrelated GDP per capita. We use the ADF test to control null hypothesis H_0 which in our case is the random walk of the series. Consider a simple AR (1) process:

$$Y_t = \rho Y_{t-1} + e_t$$

If ρ is equal larger than 1 then the series is non-stationary and the variance of Y increases with time and approaches infinity, otherwise Y is a trend- stationary series. Thus the null hypothesis is rejected if ρ is less than 1. Under the ADF test:

$$Y_t = a Y_{t-1} + e_t$$

Where $\alpha = \rho - 1$ the null and alternative hypothesis can be written as:

$$H_{0:}\ \alpha = 0$$
$$H_1:\ \alpha < 0$$

And evaluated using the conventional t-ratio for α:

$$t_a = \frac{\hat{a}}{se(\hat{a})}$$

Where $\hat{a}$ the estimation of α and se ((a)) is the coefficient standard error. Under the null hypothesis the statistic doesn't follow the student's t distribution and they derive asymptotic results and simulate critical values for various samples and results. The hypothesis is tested under the t- ratio.

We selected a series from the 3 NAFTA countries (Canada, Mexico and USA). GDP per capita series is of course non stationary, so we used GDP per capita growth annual data

for each country for 63 years (1950-2012) in order to check the length of the business cycles. The sample was cut for each country in two pieces one before the year of NAFTA foundation (1950-1993) and four for the year of foundation and after (1994-2008),(1994-2009),(1994-2010), (1994-2011) and (1994-2012) in order to see the periodicity change over the years. We used the Conference Board and Groningen Growth and Development Centre, Total Economy Database, as it was on March 2013 report. We had also quarterly data for all these countries, but when we checked its ability to find periodicity was overlapped by series noise. Our sample is over than double to the previous studies (20-22 years compared to 63) and it can explain long term development changes happened.

We have chosen to filter the series with HP (Hodrick – Prescott) filter which is appropriate for annual macroeconomic time series using the software EVIEWS7™ HP filtering process. The filter is trying to minimize the value of Y around S subject to a penalty that constrains a second difference of S. That is what the HP filter chooses to minimize:

$$\sum_{t=1}^{T} (y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1} ((s_{t+1} - s_t) - (s_t - s_{t-1}))^2$$

The penalty parameter λ controls the smoothness of the series. The larger λ the smoother the σ. As suggested (Ravn and Uhlig, 2002) the λ for annual data should take the value 6.25. Following these steps we had filtered our series. We had also quarterly data for all these countries, but when we checked its ability to find periodicity was overlapped by series noise.

We used the statistic software SPSS™ for this analysis and its tool of spectral analysis with weight Tukey – Hanning and span 3 the closer odd integer higher than the smallest period (One year for this sample). We plotted spectrograms comparing the changing periodicity. The spectrograms results are given to the table below.

Table no. 1 Cycles before and after NAFTA

Country	Canada	Mexico	USA
Frequency before NAFTA	7.4	18.4	20.3
Frequency after NAFTA (2008)	4.2	7.7	4.2
Frequency after NAFTA (2009)	4.2	7.7	4.2
Frequency after NAFTA (2010)	5.5	9.7	5.5
Frequency after NAFTA (2011)	9.2	11	7.4
Frequency after NAFTA (2012)	15	14.6	14

We can see that the countries that founded NAFTA have now smaller cycles than before with the exception of Canada which had the smallest cycle (7.4 years) with Mexico and USA counting 18.4 and 20.3 respectively. Using the first two periods data the cycle frequency has been reduced to 4.2 for USA and Canada and 7.7 years for Mexico. Begging from 2010 the frequency for the two countries raised to 5.5 years and to 9.7 years for Mexico. Canada reached and lowered its pre-integration cycle frequency to 9.2 faster than any other in the union. The others also reached lower frequencies 11 years for Mexico, and 7.4 for USA respectively. Adding the integration's 18th year period (2012) increased the cycle length to 14.6 for Mexico and to 14 years for USA. Canada seems to grow its business

cycle's length benefiting of the integration in the present period. J curve similar to the EU case is also present.
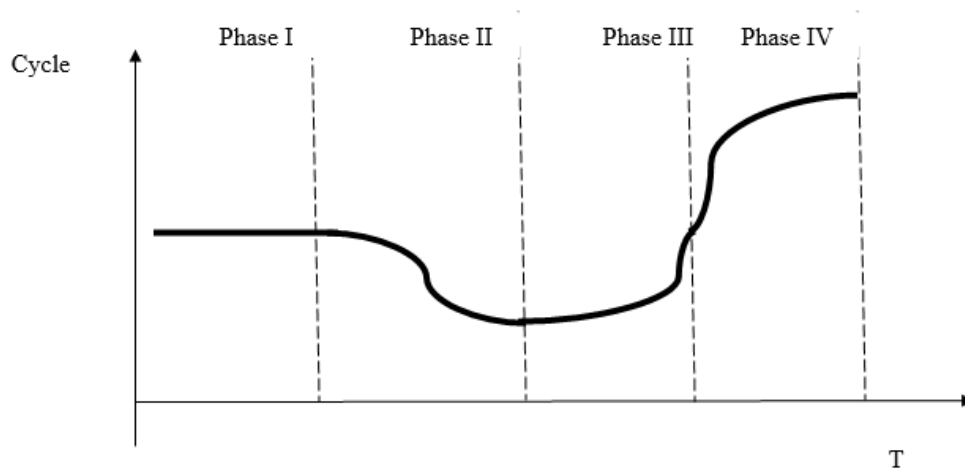

Diagram no. 1 J curve on cycle phase

The production orientation is not clear enough on primary stages. The priorities change and they lead production to specialization, because the countries can now import cheaper and higher level technology from abroad through economic union's mechanisms easier that before. Traditional industries in these countries close because of higher competition level subventions cannot be effective enough due to lack of previous experience on handling them. The whole economy infrastructure has to change in order to meet the union's standards. The countries transferred funds from agriculture and raw materials production to the manufacturing sector where the cycles tend to be smaller and prices volatility higher. Investing in technology from abroad effects basic balance of the receiving country, raising its deficit.

The whole process cannot be fully programmed due to the developing nature of the economy's future structure, so the industries that the country will be specialized are under review and economy's walk to further development is random because the orientation is not so clear on the first stage. (Phase I).

All this turbulences to the economy that caused smaller frequency cycles end when the economy finds it's orientation in the union's structure. Basic Balance deficits reduce and economy enters a phase of high development using the infrastructure and the early years investments (Phase II).

On the third Phase the economy has restored its balance and the cycles length is equal to the pre-union's ones. The early effects of the joining passed and economy from now on can lead to a successful path of receiving stabilizing benefits from the union.

Finally, the fourth phase makes membership on a union profitable after the first years of participation. Specialization had effect on making a strong and tranquil economy and the long term investment that made were successful. Thus, the country has now bigger and smoother cycles than before.

In the Mexico and USA cases the integration had the expected effect. This change means that countries that integrate in an economic area, such as the NAFTA countries face business cycle reduction for the first years but later they achieve a possible target of lower

frequency compared to the pre-integration period and finally developing lower cycle frequencies. These countries face a major change in their economies that can also explain this phenomenon. They transferred funds from the traditional industries to non-product manufacturing activities (US products are manufactured and imported from southern Asian countries or China) and added value refers only to importing, promoting and merchandising activities. In Mexico the production has been reoriented to products with smaller product life cycles and raw or fundamental products (such as oil) with raised prices volatility. The J curve as also presented in the case of EU is on its third face starting to pass by smaller cycles and tending to follow the equal and higher cycles of the fourth face.

That concludes the existence of a J curve effect for the length of the business cycle against time. In the first phase the country hasn't accessed NAFTA yet and it has a reference initial business cycle. On phase 2 or early access the cycle is smaller than the initial one until it reaches a bottom. The cycle length rises on phase 3 or equal phase until it reaches the initial periodicity. On the final phase the business cycle is larger than before the integration to a multinational scheme.

4. CONCLUSIONS AND FURTHER RESEARCH PROPOSALS

The spectral analysis shows that the countries in an initial period which can vary tend to have smaller cycles than they used to before the year of accession. They have to reach their prior periodicity or even raise their period in the future. The bigger business cycle has major advantages for a country related to easier, smaller and rarer shocks on the economy at the recession phase of their cycle. The economic environment of post-world war II era has helped countries to develop through economic integration schemes such as NAFTA, helping them definitely to set their economies in a stabilizing path. Surprisingly, Canada seems to have lowered its frequency since the NAFTA beginning. The other two countries followed the J curve as the countries define their new role as a single market. This period can vary as the case of EU presented from 15 to 24 years. On NAFTA's 18th year the two countries tend to follow relatively growing cycles compared to the early years and tending to raise to equal or larger cycles in years to come.

In a further research development countries from other older economic unions such ASEAN can be examined for their possible periodicity and the framework can be also expanded and winded through explaining the recessions with macroeconomic variables even if they are not strictly connected with growth itself.

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Notes

[1] Austria, Denmark, Finland, Greece, Ireland, Portugal, Spain, Sweden and the UK

[2] Iceland, Norway, Switzerland and Turkey

[3] Smoothing near the end of the series is accomplished via reflection. If the span is 5, then the second spectrogram is smoothed by averaging the first, third and fourth values and twice the second value. See (Priestley, 1981).