Synchronization of cycles (business cycles, credit cycles, monetary cycles), the case of France

Mamadou NIANG, Dioncounda DIARRA, Agui TCHABOU

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Abstract

This dissertation analyzes the potential interactions that may exist between cyclical fluctuations in credit, real activity and the currency in France. After an estimation of the cycles by the filter of Hodrick and Prescott (1997), they are characterized by the algorithm of Bry and Boshan over the period from 1993 to 2020. Three methods of analysis of synchronizations between the cycles were used : analysis of turning points, determination of concordances indices and calculation of dynamic cross-correlations between the cyclical components. Our study shows a procyclicality between credit and real activity and also between real activity and money. However, the relationship between credit and money is countercyclical.

1 INTRODUCTION

Contrary to some speeches spread in recent years, the economic news of the end of the year 2008 has once again come to light that the economic cycles, which had emerged with the Great Depression of 1929, with the theory of credits initiated by Von Mises (1933)[27] and Hayek (1933 ; 1935)[18] were not dead. In the wake of the subprime credit crisis in the United States in the summer of 2007, the international financial crisis has once again created risks of economic recession on both sides of Atlantic. But not that, it also revived the old debate on the link between the variables of real activity and those of the financial system. Indeed, there may be more or less consequent amplification of economic fluctuations during the period of financial crises, as several theoretical and empirical contributions try to prove. These crises did not leave France stranded. Indeed, it was among the last and middle developed countries to be impacted by that of 2008. However, the most recent and topical, that of covid-19 continues to have a significant impact on its economy.

The co-movements between the variables of economic activity and those of credit have long been studied. In addition to the analysis of activity co-movements, our study will focus on those of the variables of credit and money ; and those of activity and money. Indeed, these choices can be explained by the existence of numerous literary contributions on the behavior of bank credit in the transmission of monetary policy via the role of credit in financing consumption and productive investment through capacity from monetary policy to acting on the supply of loans granted by banks.

These themes are largely relevant in the case of France given the higher or lower number of loan applications and the low level of liquidity in the financial market. It therefore seems interesting for French to study the links between cyclical fluctuations in credit and those in economic and monetary activity. Because being an economy strongly open to the outside, it is not immune to the repercussions of international crises. In this sense, the empirical verification of the synchronization of business, credit and monetary cycles remains important for understanding the interaction between variables. To do this, we will carry our study over a more or less wide period of twenty (20) years from 1990 to 2020.

The determination of our work plan assumes that there is no single definition of the business cycle. We propose to study three approaches to synchronization of economic cycles. The first is the decomposition and comparison of the different components of the cyclic series. The second consists of an evaluation of the index of concordance, and on the last, the dynamic cross-correlations of the series. Indeed the comparison of the results obtained by these different methods will make it possible to consolidate the reliability of our study. After a more or less general review of the literature on our subject, the rest of our thesis will be organized as follows : a presentation of the different methods of synchronizing cycles, namely : the decomposition of the different phases of the cycle, the index concordance and dynamic cross-correlations ; and finally the application of our methods and the analysis of our results.

2 LITERATURE REVIEW

In recent years, numerous episodes on the analysis of the links existing between the demand for credit and economic activity have confirmed the important role played by the banking system in the development and amplification of business cycles without necessarily provide irrefutable empirical validation. Some current theoretical and empirical work suggests a certain decorrelation between the evolution of credit demand and the economic activity. Thus, Kuttner and Friedman (1993) [21] describe a way to separate the demand for credit of companies and the demand for credit of households, assuming that these two agents are not constrained in the same way by factors of supply. Household credit demand will be pro-cycle to the business cycle because in a period of recession, interest rates are high, households will not tend to resort to bank loans. But for businesses, they suggest that at the onset of a recession, businesses may face liquidity constraints. Due to a lack of cash, the increased working capital requirement linked to the increase in inventories cannot be financed from the company's own resources itself. Companies will therefore tend to resort to additional loans from banks and those despite high interest rates. Gertler and Gilchrist (1994) [13] have shown this empirically in the case of American companies. Thus, a slowdown in growth, or even a decline in economic activity, can lead to an increase in the demand for credit, as companies want to replenish their inventories in order to foresee a recovery in economic activity after a downturn. recession.

However, the "credit channel" school establishes a correlation between changes in credit supply and activity. In times of growth, investment is accompanied by demand for financing which leads to an expansion of credit and therefore an acceleration of growth. Recession, the risks of default are revised upwards so there is a credit restriction and consequently a decline in demand for credit deepening of the recession. Fisher (1933) [11], He seeks to show how the debt cycle (the credit cycle) of agents contributes to the business cycle and to financial crises. He will show that any crisis is preceded by over-indebtedness, then by deflation which will emerge from a desire for deleveraging by agents. Beginning in the 1970s, Minsky (1964)[22] brought Fisher's theory back to life. Minsky uses the same type of diagram as Fisher, but he will insist on the mode of financing of the agents. However, the decline in the distribution of credit in times of recessions is not only due to the decline in the supply of credit. It is also due to the drop in demand for credit.P Artus (2008)[2] "It is necessary to be able to separate the effects of supply and the effects of demand in order to be able to judge the responsibility of banks in crises". The Credit Channel allows the analysis of all the repercussions that variations key rates may have on the credit supply :
- Strict bank credit channel : the change in key rates modifies the refinancing conditions of banks on the money and financial markets. So also their ability to create money, that is to say their production of credit to the economy donated to companies and household consumption. The model of Bernake and Blinder (1988)[4] shows that by reducing banks' access to loanable funds, open market operations (central bank intervention in the money market can lead to a change in key rates on interbank markets) limit the supply of bank loans.
- Broad credit channel : It is the quality of the balance sheet structure of economic agents that comes into play, as in the financial accelerator theory of Bernanke and Getler (1988)[12] but not considering the impact of a real shock but that of monetary policy on the external financing premium. A change in interest rates affects the structure of balance sheets, and therefore the external financing premium. A rise in rates will then have more significant depressive effects if private agents are already heavily indebted.

The size of banks can also play a major role in the distribution of credit in the economy, thus impacting the business cycle. In this sense we can note the empirical studies of Kashyap and Stein (1994)[20] observed on American data. Indeed, they show that in the event of a decrease in the money supply, small banks find it more difficult to find external financing. Knowing that an economy has more medium-sized banks than large banks. When we look at the balance sheets of banks, we can see that local (medium-sized) banks mostly remain in the traditional banking activities (loan distribution), while the large universal banks operate mainly in the financial markets. the financing difficulties of small banks will have effects on the distribution of credits because they are those which remain the most in the traditional banking activities. Another major fact in economics that can have a real impact on the distribution of credit is information asymmetry. The information asymmetry is the fact that all agents do not have the same information that can restrict the lender to lend to borrowers, we can highlight the work of Goyer (1995) [14] .

3 SYNCHRONIZATION OF CYCLES

3.1 Description and Extraction of cycles

According to Burns and Mitchell (1946)[6] "Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises : a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle ; this sequence of changes is recurrent but not periodic ; in duration business cycles vary from more than one year to ten or twelve years ; they are not divisible into shorter cycles of similar character with amplitudes approximating their own ".

We use two approaches to extract economic cycles. Christiano and Fitzgerald's method (2003)[7] and Hodrick and Prescott's method (1997) [19]. Like Corbae and Ouliaris (2006)[9], several articles use the band pass filter method of Christiano and Fitzgerald (2003) to extract economic cycles. The choice of this method is undoubtedly based on three main reasons : first, it gives the user the possibility of choosing the length of the cycle frequencies according to the data processed ; second, it facilitates the identification of cyclical elements by appropriately removing very short-term volatility from time series.

Hodrick and Prescott decomposition equation :

$$Y_t = g_t + c_t + \epsilon_t \tag{1}$$

The H-P filter (Hodrick and Prescott (1997) filter) considers that for any t going from 1 to T, the stationary series Y_t is the sum of a stochastic trend g_t and a cyclic component c_t. Indeed, this method consists in determining Y_t, its tendency, which minimizes the following expression :

$$Min_{gt}(\sum_{t=1}^{T}(Y_t - g_t)^2 + \lambda \sum_{t=1}^{T}[(g_t - g_{t-1})(g_{t-1} - g_{t-2})]^2)$$

The first term of the minimization program measures the distance or conformity between the series and the trend. Lambda (λ) is the smoothing parameter. It adjusts the relative importance of the two terms. The λ smoothing parameter also represents the degree of penalty given to the second objective relative to the first, hence the second name penalty parameter. He plays. The higher the λ, the more the objective of smoothing the trend is privileged to the detriment of the match to the raw series and therefore the more the cyclical part is important (Cogley and Nason (1995)[8], Sobczak, Ra-bault, and Doz (2014)[26], Pedersen (2001)[24], Guay and St. Amant (2005) [15] and Schlicht (2004)[25]). Beforehand, hodrick and prescott (1997) propose arbitrary values for λ. Let equal 100 ; 1600 ; 14,400 for annual, quarterly, and monthly data respectively. The H-P filter allows trends to be calculated even for extreme observations without the need to extend the date of the initial series. We will use this last filter for the extraction of our cycles.

The methodologies used for dating cycles are numerous. We can cite the so-called classic. It has a non parametric approach developed by Bry and Boshan (1971) [5]. The cycle is defined from the level of a variable as a succession of phases of expansion and recession. Each of them having a minimum duration of 6 (six) months, due to the monthly data used. It is therefore necessary to precisely identify the turning points. From the turning points, a recession (expansion) phase separates a peak (trough) from a trough (peak). In its original form the algorithm was intended for the study of monthly data and aimed to repeat the procedure of NBER[23] for a single series industrial production. This algorithm was then adapted to quarterly databases by Harding and Pagan (2001) [15].

We can characterize a cyclical component from the calculation of these main indicators : - Depth, which corresponds to the magnitude of the recession or expansion and is defined by :

Depth= $\frac{X_p - X_c}{X_p}$

X_p serial value at peak and X_c trough value

- Severity summarizes the information contained in duration and depth. In addition, it measures the loss (respectively the gain) achieved by a variable during a contraction phase (respectively an expansion phase). It is calculated according to the formula : Severity = depth x duration

3.2 The concordance index

Harding and Pagan (2002 and 2004)[17] have developed a simple methodology to measure whether two series are found in the same phase ; recession or expansion. This index allows us to appreciate the link between the phases of recession and expansion of two series x and y. it measures the fact of finding in a significant way two series in the same cycle. It is formally determined by :

$$IC_{x,y} = \frac{1}{T}{}_{t=1}^{T}[S_{x,t}.S_{y,t} + (1 - S_{x,t}).(1 - S_{y,t})]$$

with

$$S_{z,t} = 1$$

$$IC_{x,y} = 1 + \frac{2}{T}\sum_{t=1}^{T} S_{x,t}.S_{y,t} - \frac{1}{T}{}_{t=1}^{T} S_{x,t} - \frac{1}{T}{}_{t=1}^{T} S_{y,t}$$

$$IC_{xy} = 1 + 2(\frac{1}{T}\sum_{t=1}^{T} S_{x,t} * S_{y,t} - \mu_{sx}\mu_{\mu y}) + \mu_{Sx}\mu_{Sy}\frac{1}{T}{}_{t=1}^{T} S_{x,t} - \frac{1}{T}\sum_{t=1}^{T} S_{y,t}$$

$$IC_{xy} = 1 + 2COV(S_{x,t}; S_{y,t}) + 2\mu_{Sx}\mu_{Sy} - \mu_{Sx} - \mu_{Sy}$$

$$IC_{xy} = 1 + 2\rho_s \sigma_{S_x} \sigma_{S_y} + 2\mu_{S_x} \mu_{S_y} - \mu_{S_x} - \mu_{S_y}$$

The concordance index takes the value of 1 if we have a perfect match, there is a perfect juxtaposition of expansions and recessions, series are still in a same phase. It takes the value of 0 if there is no match, then the series are constantly in opposite phase. Also with the last equation Harding and Pagan show an equivalence between IC_{xy} and ρs. We can measure the significant of the concordance index by measuring the significant of ρ_s. To determine ρ_s we can use the following linear model :

$$\frac{S_{y,t}}{\sigma_{S_y}} = \alpha + \rho_s * \frac{S_{x,t}}{\sigma_{S_x}} + \epsilon_t$$

3.3 Cross dynamic correlations

As mentioned, concordance indices measure the degree of "juxtaposition" between two time series, without addressing the issue of a possible presence of a trend in the variables (non-stationary problem). Moreover, this is only one aspect of the concept of the cycle. The analysis can be extended by keeping the notions of phase and duration, without being limited to the manipulation of indicators as limiting as the concordance indices. So a second approach based on the correlation calculation between the stationary components of the variables. We will study the correlations of the smoothed cyclic components of the series obtained from the filter of Hodrick and prescott (1997). As a reminder, the cyclic components obtained after smoothing are without trends and therefore stationary. So we will use these for each variable and calculate the cross correlations between them. More precisely, we will take a cyclic component for each variable and calculate the correlations between the cyclic parts of the different series. The robustness of the analysis is supported by the estimation of the dynamic correlations between the variables (Croux and al. (2001)[10] ; Avouyi-Dovi and al. (2006) [3])

Generally, if the cyclical component of Xt and Yt (delayed or advanced component of k periods), then the cyclical components co-movements analysis of the different phases (expansion and recession) will be based on the approach next :

Supposed that X_t is credit and Y_t the production index, $\rho(k)$ is the cross correlation coefficient between X_t cyclical component and Y_t cyclical component delayed or advanced by k period :

credit is procyclical, if :

$$K^* = Arg(max|\rho(K^*)|) \rightarrow \rho(K^*) > 0$$

credit is acyclical if

$$0 < |\rho(K^*)| < \frac{1}{\sqrt{N}}, \forall K$$

credit is contracyclical,if :

$$K^* = Arg(max|\rho(K)|) \rightarrow [\rho](K^*) \leq 0$$

otherwise, the previous relations can be classified according to the level of significance. relation between cycle of credit and cycle of activity significant if threshold 5 percent

$$|\rho(K)| > \frac{1}{\sqrt{N}}$$

or if

$$\frac{2}{\sqrt{N}} < |\rho(K)| < 1$$

significant if threshold 10 percent :

$$\frac{1}{\sqrt{N}} < |\rho(K)| < \frac{2}{\sqrt{N}}$$

- For k = 0 a significantly positive correlation indicates a similar behavior of the cyclic components of the two variables (pro-cyclical). Conversely, a negative correlation corresponds to an opposition in behavior between the two components and therefore counter-cyclical.

- For k = -1 (+1) a maximum correlation indicates that the cyclical component Xt lagging behind and therefore follows (ahead) by one month the component Yt case of monthly data. In our study we will use data ranging from k = -24 up to k = + 24 months.

4 APPLICATIONS TO FRENCH DATA

To apply the methods previously cited in the case of France, we used the manufacturing production index, the consumer credit of residents and the monetary aggregate M3. For resident consumer credit and monetary aggregate M3 ,data comes from the Bank of France website. For the manufacturing production index, the data was imported from the French National Institute of statistics and Economic Studies (INSEE) website.The data series cover the period from May 1993 to May 2020. Beforehand, all the series have been transformed into a logarithm.

4.1 Phases of cycles

The estimated turnaround dates of the smoothed cyclical components are returned in Annex A. (Table A1) for the manufacturing production index, (Table A2) for the monetary aggregate M3 and (Table A3) for credit. A visible gap appears between the phases of credit cycles and those of activity determined by the manufacturing production index ; and also, between the phases of the credit and M3 cycles. On the other hand, for the phases of the business cycle and the monetary ones, we do not observe a significant lag. However, there are more turning points for the credit component. The main lessons that can be drawn from our turning point tables are :

a- The manufacturing production index has on average 10 cycles between the period of November 1993 and June 2020. The cycles are generally divided into two large parts : from 1993-04 / 2008 which present more or less sensitive fluctuations and from 04 / 2008 until June 2020, with a sudden and rapid recession phase from April 2008 to March 2009. This phase is explained by the 2008 recession crisis. We also notice a big recession phase at the end of 2019 which may be explained by the current covid-19 crisis. The different phases of expansion and recession can be found in Table A1.

b- Overall the expansion phases of M3 correspond to the periods : 09/1994-12/1995 04/1997-04/1998 12/1998-12/2001 06/2003-04/2006 12/2006-01/2008 10/2009-12/2010 07/2011-01/2012 04/2014-01/2015 12/2015-09/2017. There has also been a period of recession from the early 1990s until September 1994, which can be explained by the so-called ”recession of the 1990s”. The French economy, which was already hit by the gloomy world economy in 1991 and 1992, was still severely impacted by monetary stability in Europe. Thus around 1992-1993, France suddenly entered a violent recession. The latter is due, among other things, to the exit of its neighbors from the monetary system, namely the United Kingdom and Italy, which has made French companies more competitive. We also note a period of recession which lasted nearly 18 months between 2001 and 2003 because of the change from the franc to the single currency (euro).

c- The phases of the credit cycle are the most numerous. With a total of 11 cycles between 1993 and 2020, credit has quite logically experienced more recession and expansion during this period in France. There is a long expansion phase of almost 08 / 1998-01 / 2000. Indeed, the French economy has remained at a sustained rate of expansion, thanks in particular to household consumption and large business investment. This could explain a sustained increase in consumer credit requests. The 2008 crisis was not indifferent to credit as shown in graph A3.

Table 1 – turnaround dates of Manufacturing Production Index

	peaks	troughs	Duration
1	NA	1993M11	NA
2	1994M11	1997M1	26
3	1998M8	1999M8	24
4	2001M3	2003M6	27
5	2004M2	2004M8	6
6	2008M4	2009M3	11
7	2011M5	2012M11	18
8	2013M11	2014M5	6
9	2016M1	2016M10	9
10	2017M12	2018M9	9
11	2019M1	NA	NA

Table 2 – turnaround dates of M3

	peaks	troughs	Duration
1	NA	1994M9	NA
2	1995M12	1997M4	16
3	1998M4	1999M12	8
4	2001M12	2003M6	18
5	2006M4	2006M12	8
6	2008M1	2009M10	21
7	2010M12	2011M7	7
8	2012M1	2014M4	27
9	2015M1	2015M12	11
10	2017M9	2019M6	21

Table 3 – turnaround dates of Credit

	peaks	troughs	Duration
1	NA	1994M3	NA
2	1994M11	1995M8	9
3	1996M12	1998M8	20
4	2000M1	2001M8	19
5	2002M5	2003M2	9
6	2004M6	2005M2	8
7	2006M6	2007M2	8
8	2008M6	2009M4	10
9	2009M12	2011M9	21
10	2012M12	2013M8	8
11	2015M12	2016M8	8
12	2017M12	NA	NA

4.2 The concordance of cycles

To analyze the degree of agreement between the different phases of the business, credit and monetary cycles, the concordances indices were calculated. The results obtained are in table 1. The results in table 1 show a concordance between the phases of the business cycle determined here by the manufacturing production index and the monetary cycles determined by M3. In France, the concordance index describes a synchronization of business and monetary cycles in significantly more than 56 percent of cases. According to the significance criteria of Harding and Pagan (2002) [16], we notice that at the 5percent threshold, the concordance index between credit and the production index are not significant but the concordance indices between credit-M3 and between index production-M3 are significant. This perfectly corroborates our recent analysis of the co-movements of the boom and bust and guarantees its reliability. However, a lack of significant agreement does not necessarily mean that the cycles taken two by two are entirely disconnected. In our case, the result simply means that the phases of expansion of manufacturing output and credit do not coincide.

TABLE 4 – Concordance indices results

	concordance index	ρ_s	p-value
cz - credit	0.52	0.039	0.489
cz - M3	0.56	0.121	0.029
credit - M3	0.43	-0.133	0.016

4.3 Analysis of cross-correlations

The activity cycle is defined as the set of movements whose reproduction period falls within a given time interval. According to the NBER, the business cycle time interval is set between 18 and 96 months. However, Anas et al. (2004)[1] use an interval between 18 and 72 months for the analysis of production in the euro zone. In our case we will adapt the second definition (that of Anas et al (2004)). This choice can be explained by the size of our sample. In fact, we have nearly thirty years of observations.

- The analysis of the cross-correlations table () between credit and M3 shows that credit is counter-cyclical in the case of France. Indeed when k = 0, we find a significantly negative correlation. However, the maximum correlation is found when k = -21, which results in a delay of the credit cycle of 21 months on the money cycle. In other words, the cyclical component of credit follows that of monetary with a delay of 24 months.The money cycle causes the credit cycle 21 months later. - Our table () shows that the cyclical components of credit and activity are contemporary. Credit is pro-cyclical when analyzing the timing of business cycles and credit. When k = 0 we obtain the maximum and significant positive cross-correlation between credit and IPM. The two cycles coincide. There is no delay between the two cyclic components. This, however, remains contradictory with the results of our analysis after studying the concordance index. - The cyclical monetary components are ahead of the cyclical components of activity by 8 months. In fact, the maximum value of the cross correlations between the cyclical component of the production index and that of M3 is obtained when k = 8. Business and monetary cycles are positively correlated. We find a positive correlation when k = 0.

4.4 Variation of λ in Hodrick-Prescott's filter

After a variation of λ (used during the extraction of cycles with Hodrick-Prescott's filter) which move to $\lambda = 14400$ to $\lambda = 16400$ all the results presented throughout our analysis remains the same. These results start to relatively change when the variation is higher.

TABLE 5 – Concordance indices results $\lambda = 18400$

	concordance index	ρ_s	p-value
credit-cz	0.48	-0.034	0.535
M3 - cz	0.58	0.160	0.003
credit - M3	0.42	-0.159	0.004

The analysis of new concordance indices results does not add very important changes on our interpretations made before with $\lambda = 14400$, they effectively remains the same. We can see that the level of concordance indices and their significant are relatively similar even if for credit-cz we notice a decrease of 4 points of percentage and for M3-cz an increase of 2 points of percentage about the concordance index.

With $\lambda = 18400$ the results of cross correlation analysis let appears that the relations between credit cycle, activity cycle and monetary cycle remains the same as we see on Annex (Tables B1,B2,B3). We also notice that for all relations listed k is the same but the cross correlations coefficient is higher (in absolute terms) :
- For Credit-CZ we move from 0.1769 to 0.1781
- For M3-CZ we move from 0.4071 to 0.4114
- For Credit-M3 we move from 0.2157 to 0.2256

Even if these results are not significantly different from each other, the variation of lambda to 18400 reveals strongest relations between cycles in cross correlation analysis.

5 CONCLUSION

This work tried to measure the degree of synchronization between the real activity cycle, credit cycle and monetary cycle in France through the relationships between the index of manufacturing production, the consumer credit of residents and also the monetary aggregate M3. Three techniques were used in the empirical part namely ; an analysis of the turning points obtained with the Bry and Boshan algorithm (1971), then the concordance indices and finally, the correlations between the cyclic components are calculated. The strong synchronization of cycles is observed with the co-movement method. Indeed, our study shows that business cycle is strongly linked to monetary and credit cycles. Banks behave pro-cyclically on economic activity in France as well as currency. Credit is contemporaneous with activity, but money is 8 months ahead of it. On the other hand, the analysis between credit and the monetary aggregate M3 shows us that they are counter-cyclical. The pro-cyclically of credit in comparison French economic activity shows us that the development of credit is not disconnected from real activity in France. In addition, we observe a robustness of our results. In fact, we note a non-significant change in our agreement indices following upward variations in the lambda parameter up to 2000, which does not invalidate our results and reinforces their reliability. However, we notice more significant changes when lambda is greater than 16400.

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6 ANNEX

Tables A : SAS System Cross correlation results tables

credit - cz

Obs.	_NAME_	_CROSS_	LAG	N	CCOV	CCF	CCFSTD	ABS_CCF
1	s_cycle_credit	s_cycle_cz	0	325	.000100063	0.17691	0.055470	0.17691
2	s_cycle_credit	s_cycle_cz	1	324	.000090141	0.15937	0.055470	0.15937
3	s_cycle_credit	s_cycle_cz	-14	311	.000071052	0.12562	0.055470	0.12562
4	s_cycle_credit	s_cycle_cz	-19	306	.000068926	0.12186	0.055470	0.12186
5	s_cycle_credit	s_cycle_cz	-13	312	.000065819	0.11637	0.055470	0.11637
6	s_cycle_credit	s_cycle_cz	-1	324	.000062277	0.11011	0.055470	0.11011
7	s_cycle_credit	s_cycle_cz	-12	313	.000061697	0.10908	0.055470	0.10908
8	s_cycle_credit	s_cycle_cz	-20	305	.000060388	0.10677	0.055470	0.10677
9	s_cycle_credit	s_cycle_cz	-18	307	.000059648	0.10546	0.055470	0.10546
10	s_cycle_credit	s_cycle_cz	-15	310	.000055269	0.09771	0.055470	0.09771

A1

M3 - cz

Obs.	_NAME_	_CROSS_	LAG	N	CCOV	CCF	CCFSTD	CCFPROB	ABS_CCF
1	s_cycle_m3	s_cycle_cz	8	317	0.000242256	0.40712	0.055470	2.145E-13	0.40712
2	s_cycle_m3	s_cycle_cz	9	316	0.000236069	0.39672	0.055470	8.5532E-13	0.39672
3	s_cycle_m3	s_cycle_cz	7	318	0.000234370	0.39386	0.055470	1.243E-12	0.39386
4	s_cycle_m3	s_cycle_cz	6	319	0.000224933	0.37801	0.055470	9.4527E-12	0.37801
5	s_cycle_m3	s_cycle_cz	10	315	0.000222945	0.37466	0.055470	1.4346E-11	0.37466
6	s_cycle_m3	s_cycle_cz	5	320	0.000200460	0.33688	0.055470	.000000001	0.33688
7	s_cycle_m3	s_cycle_cz	11	314	0.000199858	0.33587	0.055470	.000000001	0.33587
8	s_cycle_m3	s_cycle_cz	12	313	0.000180743	0.30374	0.055470	.000000044	0.30374
9	s_cycle_m3	s_cycle_cz	4	321	0.000176512	0.29663	0.055470	.000000089	0.29663
10	s_cycle_m3	s_cycle_cz	-14	311	-.000173539	-0.29164	0.055470	.000000146	0.29164

A2

credit - M3

Obs.	_NAME_	_CROSS_	LAG	N	CCOV	CCF	CCFSTD	CCFPROB	ABS_CCF
1	s_cycle_credit	s_cycle_m3	-21	304	0.000058692	0.21577	0.055470	.000100316	0.21577
2	s_cycle_credit	s_cycle_m3	-22	303	0.000057541	0.21154	0.055470	.000136974	0.21154
3	s_cycle_credit	s_cycle_m3	-18	307	0.000056369	0.20723	0.055470	.000187071	0.20723
4	s_cycle_credit	s_cycle_m3	-20	305	0.000053720	0.19749	0.055470	.000370360	0.19749
5	s_cycle_credit	s_cycle_m3	-19	306	0.000053678	0.19734	0.055470	.000374362	0.19734
6	s_cycle_credit	s_cycle_m3	-23	302	0.000052574	0.19328	0.055470	.000493291	0.19328
7	s_cycle_credit	s_cycle_m3	-24	301	0.000049612	0.18239	0.055470	.001008798	0.18239
8	s_cycle_credit	s_cycle_m3	-17	308	0.000047401	0.17426	0.055470	.001680512	0.17426
9	s_cycle_credit	s_cycle_m3	23	302	-.000044003	-0.16177	0.055470	.003541665	0.16177
10	s_cycle_credit	s_cycle_m3	22	303	-.000042437	-0.15601	0.055470	.004915300	0.15601

A3

Tables B : SAS System Cross correlation results tables with $\lambda = 18400$

credit - cz lambda=18400

Obs.	_NAME_	_CROSS_	LAG	N	CCOV	CCF	CCFSTD	CCFPROB	ABS_CCF
1	s_cycle_credit	s_cycle_cz	0	325	.000100151	0.17811	0.055470	0.001323	0.17811
2	s_cycle_credit	s_cycle_cz	1	324	.000090340	0.16066	0.055470	0.003775	0.16066
3	s_cycle_credit	s_cycle_cz	-14	311	.000070472	0.12533	0.055470	0.023859	0.12533
4	s_cycle_credit	s_cycle_cz	-19	306	.000068539	0.12189	0.055470	0.027989	0.12189
5	s_cycle_credit	s_cycle_cz	-13	312	.000065208	0.11597	0.055470	0.036562	0.11597
6	s_cycle_credit	s_cycle_cz	-1	324	.000062129	0.11049	0.055470	0.046380	0.11049
7	s_cycle_credit	s_cycle_cz	-12	313	.000061061	0.10859	0.055470	0.050269	0.10859
8	s_cycle_credit	s_cycle_cz	-20	305	.000060087	0.10686	0.055470	0.054049	0.10686
9	s_cycle_credit	s_cycle_cz	-18	307	.000059176	0.10524	0.055470	0.057797	0.10524
10	s_cycle_credit	s_cycle_cz	-15	310	.000054712	0.09730	0.055470	0.079412	0.09730

B1

M3 - cz lambda=18400

Obs.	_NAME_	_CROSS_	LAG	N	CCOV	CCF	CCFSTD	CCFPROB	ABS_CCF
1	s_cycle_m3	s_cycle_cz	8	317	0.000257128	0.41437	0.055470	7.9936E-14	0.41437
2	s_cycle_m3	s_cycle_cz	9	316	0.000251057	0.40459	0.055470	3.0131E-13	0.40459
3	s_cycle_m3	s_cycle_cz	7	318	0.000248945	0.40118	0.055470	4.7429E-13	0.40118
4	s_cycle_m3	s_cycle_cz	6	319	0.000238991	0.38514	0.055470	3.8316E-12	0.38514
5	s_cycle_m3	s_cycle_cz	10	315	0.000237892	0.38337	0.055470	4.8006E-12	0.38337
6	s_cycle_m3	s_cycle_cz	11	314	0.000214552	0.34576	0.055470	4.568E-10	0.34576
7	s_cycle_m3	s_cycle_cz	5	320	0.000213745	0.34446	0.055470	5.3048E-10	0.34446
8	s_cycle_m3	s_cycle_cz	12	313	0.000195033	0.31430	0.055470	1.46025E-8	0.31430
9	s_cycle_m3	s_cycle_cz	4	321	0.000188893	0.30441	0.055470	4.06997E-8	0.30441
10	s_cycle_m3	s_cycle_cz	-14	311	-.000184230	-0.29689	0.055470	8.68365E-8	0.29689

B2

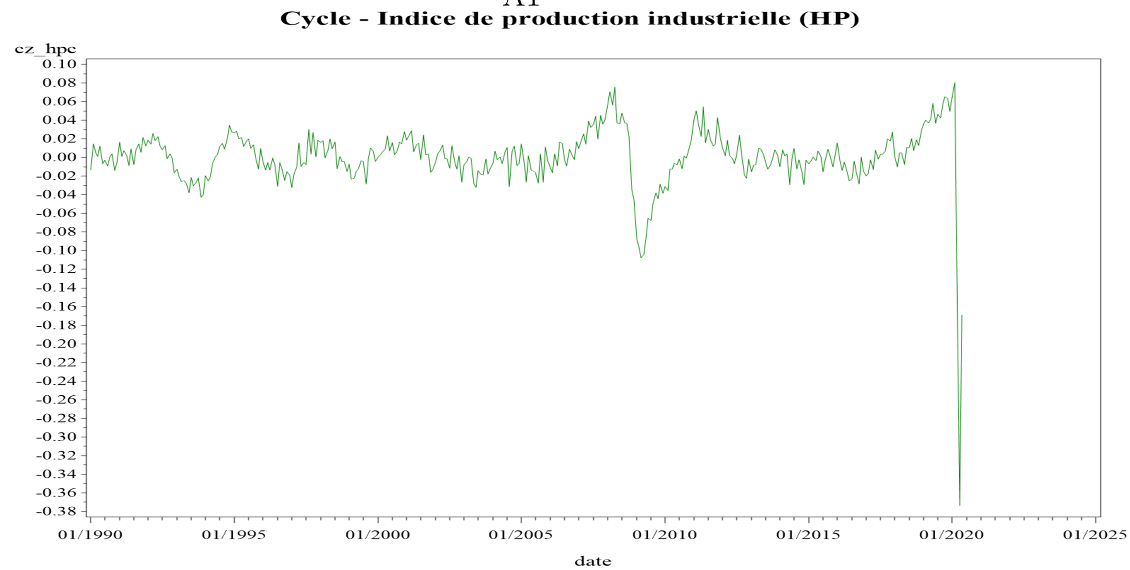
credit - M3 lambda=18400

Obs.	_NAME_	_CROSS_	LAG	N	CCOV	CCF	CCFSTD	CCFPROB	ABS_CCF
1	s_cycle_credit	s_cycle_m3	-21	304	0.000062969	0.22569	0.055470	.000047281	0.22569
2	s_cycle_credit	s_cycle_m3	-22	303	0.000061740	0.22129	0.055470	.000066265	0.22129
3	s_cycle_credit	s_cycle_m3	-18	307	0.000060866	0.21815	0.055470	.000083966	0.21815
4	s_cycle_credit	s_cycle_m3	-19	306	0.000058128	0.20834	0.055470	.000172698	0.20834
5	s_cycle_credit	s_cycle_m3	-20	305	0.000058071	0.20814	0.055470	.000175275	0.20814
6	s_cycle_credit	s_cycle_m3	-23	302	0.000056615	0.20292	0.055470	.000254057	0.20292
7	s_cycle_credit	s_cycle_m3	-24	301	0.000053485	0.19170	0.055470	.000548525	0.19170
8	s_cycle_credit	s_cycle_m3	-17	308	0.000051946	0.18618	0.055470	.000789526	0.18618
9	s_cycle_credit	s_cycle_m3	23	302	-.000045793	-0.16413	0.055470	.003087375	0.16413
10	s_cycle_credit	s_cycle_m3	22	303	-.000044367	-0.15902	0.055470	.004147047	0.15902

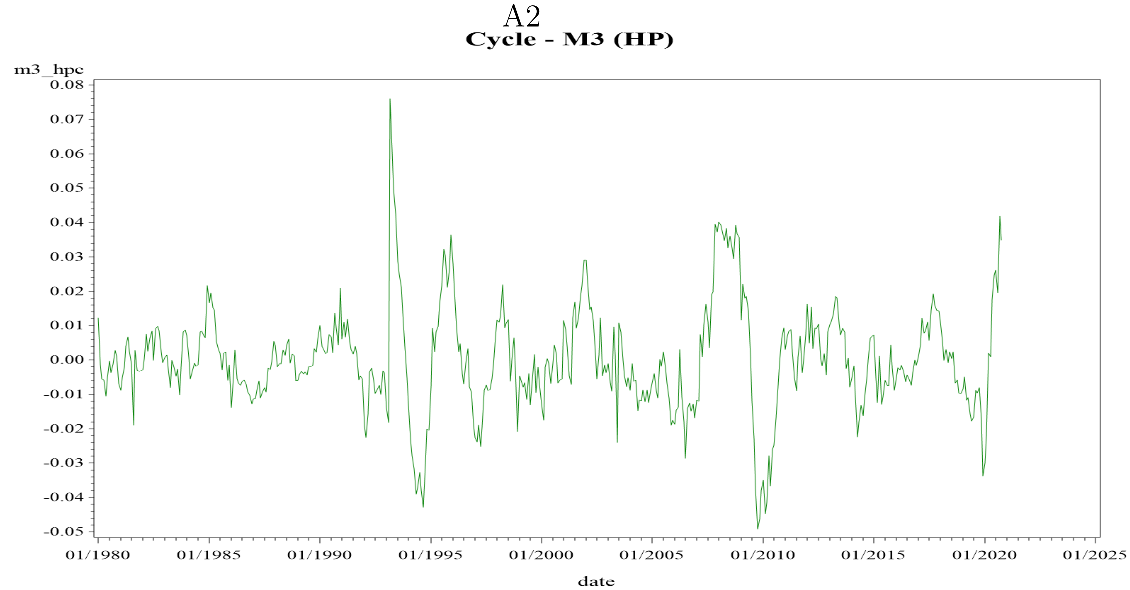
B3

Graphs A : Cyclical componant of series with Hodrick–Prescott's filter

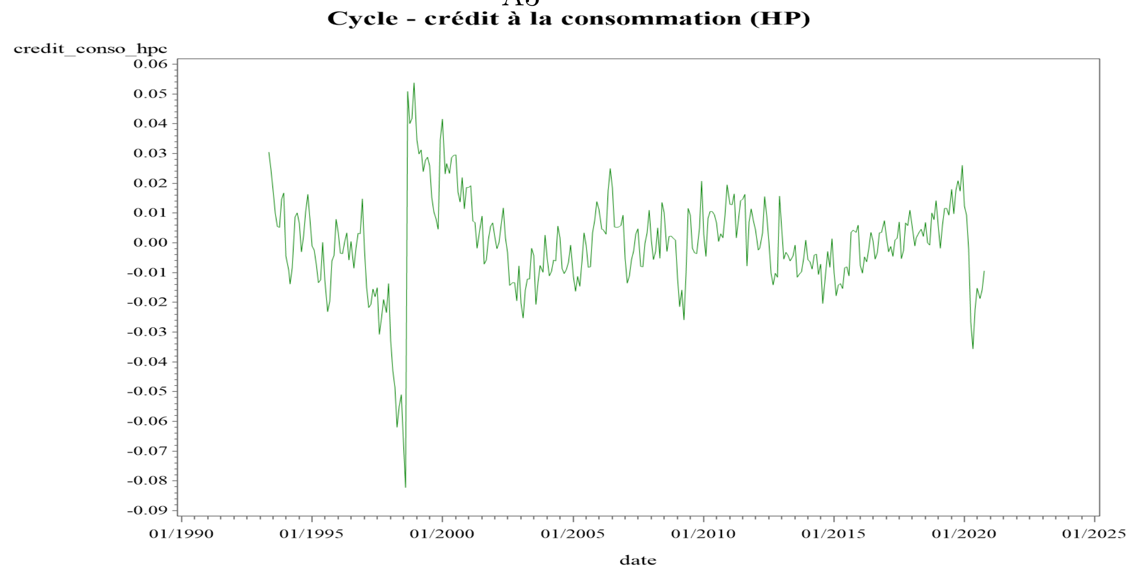
A1



A2



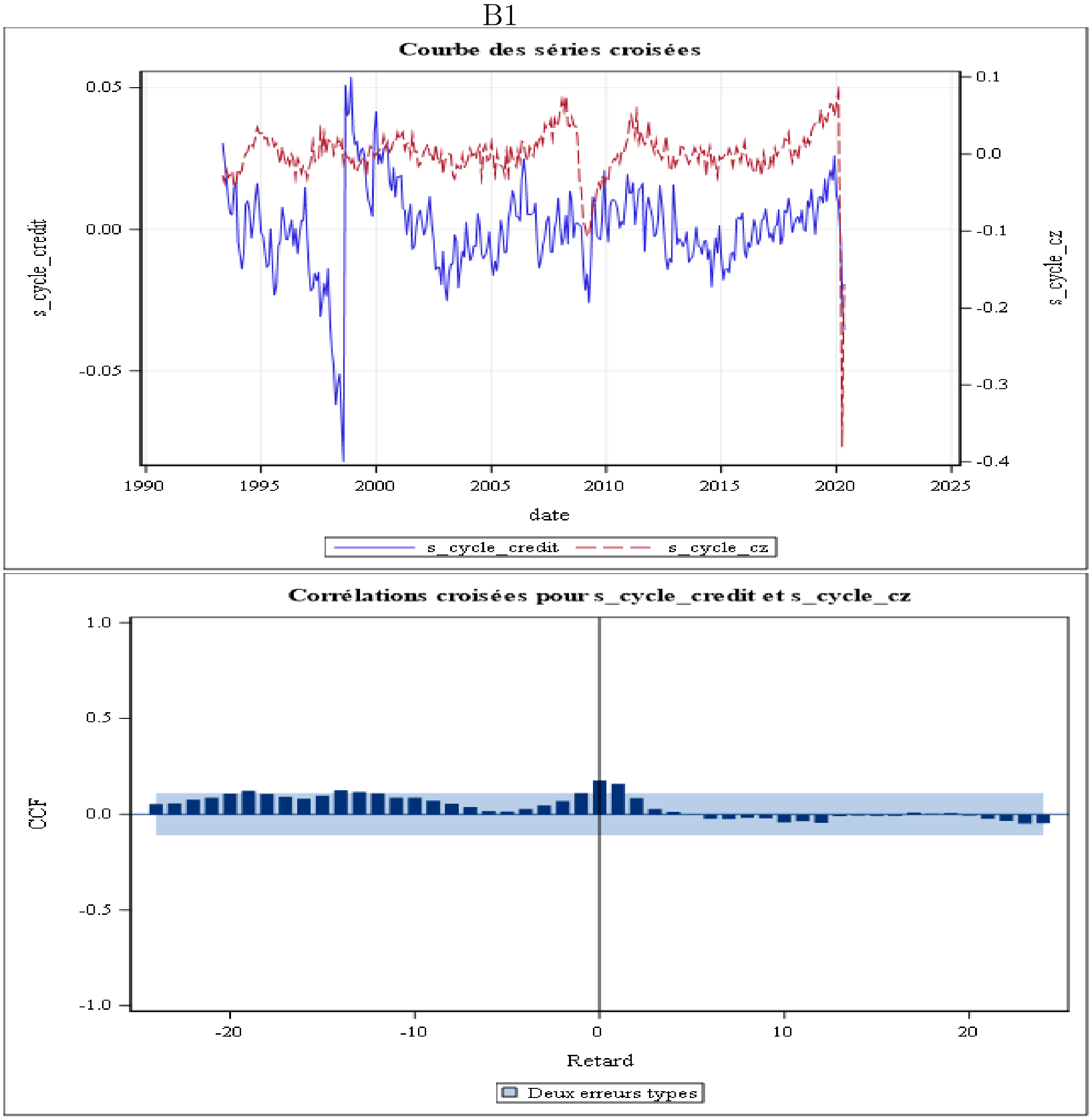
A3



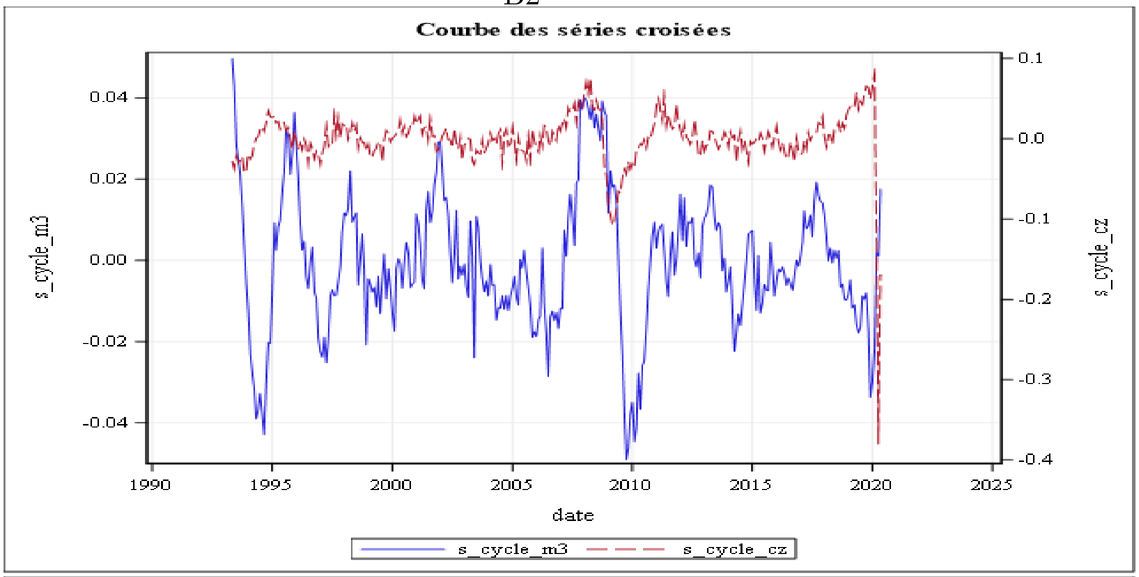
Cycle - crédit à la consommation (HP)
credit_conso_hpc
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
01/1990
01/1995
01/2000
01/2005
01/2010
01/2015
01/2020
01/2025
date

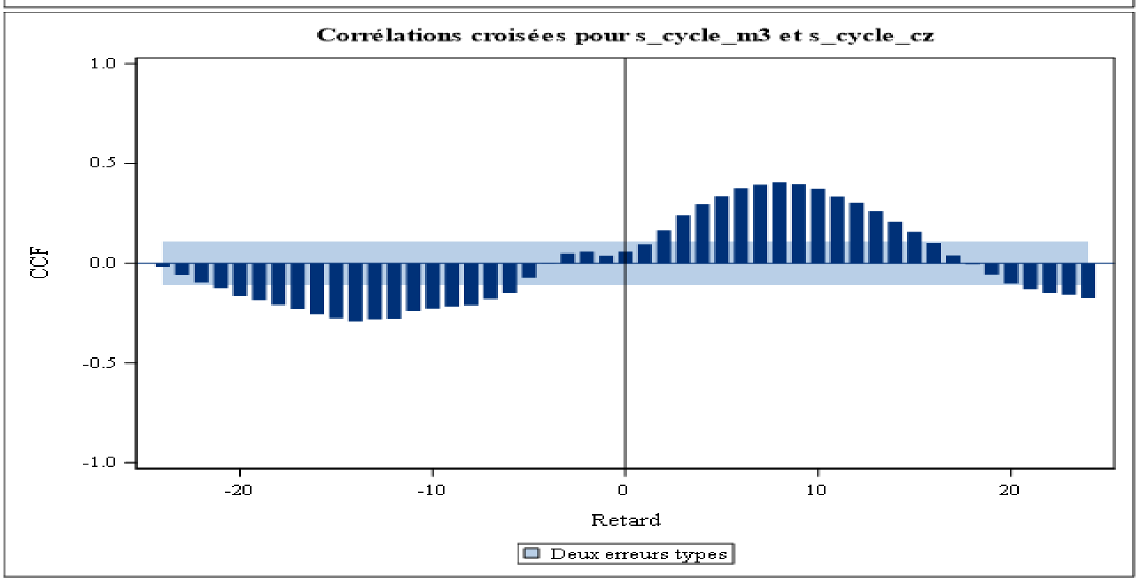
Graphs B : Cross-correlations graphics

B1

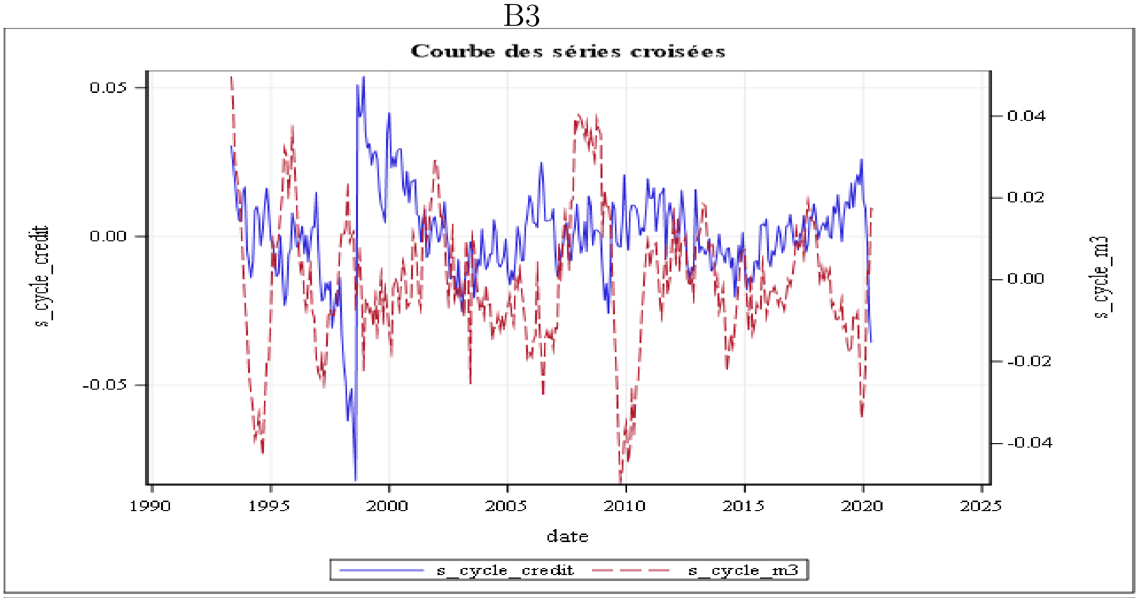


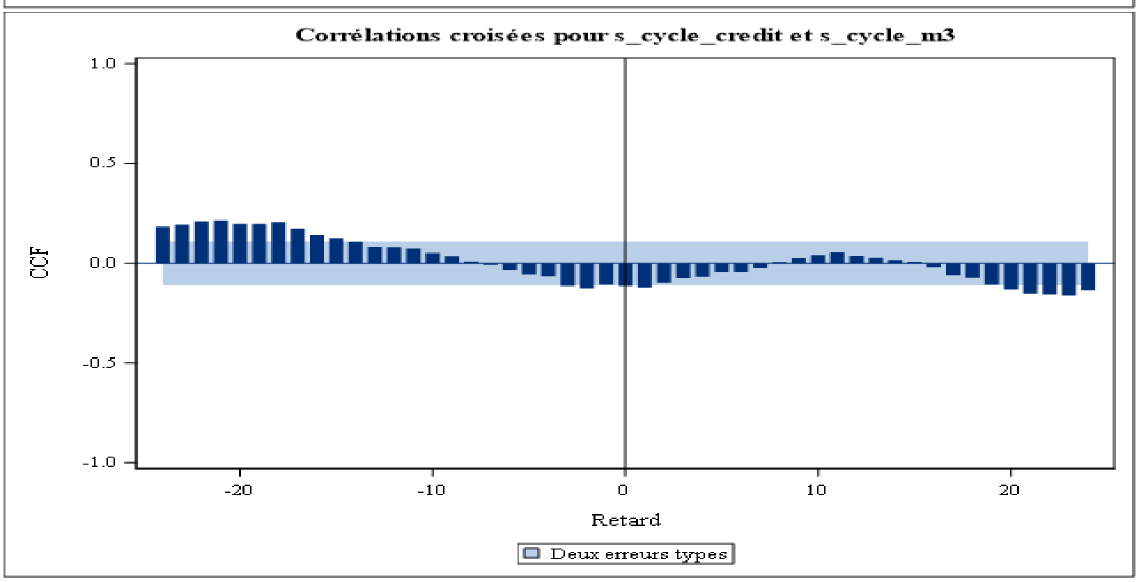
B2


Courbe des séries croisées
s_cycle_m3
s_cycle_cz
date
s_cycle_m3
s_cycle_cz
0.04
0.02
0.00
-0.02
-0.04
0.1
0.0
-0.1
-0.2
-0.3
-0.4
1990
1995
2000
2005
2010
2015
2020
2025


Corrélations croisées pour s_cycle_m3 et s_cycle_cz
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Retard
Deux erreurs types

B3


Courbe des séries croisées
0.05
0.00
-0.05
s_cycle_credit
0.04
0.02
0.00
-0.02
-0.04
s_cycle_m3
1990
1995
2000
2005
2010
2015
2020
2025
date
s_cycle_credit
s_cycle_m3


Corrélations croisées pour s_cycle_credit et s_cycle_m3
1.0
0.5
0.0
-0.5
-1.0
CCF
-20
-10
0
10
20
Retard
Deux erreurs types