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Dating business cycles in France:
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Abstract:

This paper proposes a reference quarterly chronology for periods of expansion and recession in France since 1970, carried out by the Dating Committee of the French Economic Association (AFSE). The methodology used is based on two pillars: (i) econometric estimations from various key data to identify candidate periods, and (ii) a narrative approach that describes the economic background that prevailed at that time to finalize the dating chronology. Starting from 1970, the Committee has identified four economic recession periods: the two oil shocks 1974-75 and 1980, the investment cycle of 1992-93, and the Great Recession 2008-09 spawned by the Global Financial Crisis. The peak before the Covid-19 recession has been identified in the last quarter of 2019.

JEL classification: E32, E37, C24, N14.

Keywords: Business cycles, French economy, Dating, Narrative approach, Econometric modeling

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1 Introduction and motivations

This paper presents the methodology used and the results obtained by the French Business Cycle Dating Committee of the AFSE (Association Française de Science Economique) to elaborate a reference dating chronology of French economic cycles since 1970. This Committee, composed of the authors of this document, was created in October 2020 within the AFSE in order to establish and make publicly available a historical chronology of the periods of recession and expansion in France that can be used as a reference for studies and research in economics, but also for policymakers and general audience. Besides, this Committee aims at keeping this chronology of the turning points of the cycle up to date and, if necessary, at amending it.

1.1 Why creating a reference business cycle chronology?

Several arguments justify the usefulness and importance, for different audiences, of having a reference chronology of business cycle turning points.

First, the historical study of business cycles is a long-standing research topic. One reason for this is that macroeconomists frequently include a cyclical dimension in their work, making it useful to develop chronologies to help macroeconomic analysis to decipher - and possibly anticipate - economic fluctuations through the cycle. The academic literature[1] has thus proposed various chronologies of turning points in the French economic cycle. International institutions such as the OECD, the Conference Board or the Economic Cycle Research Institute (ECRI), also propose cycle dates for France, as well as for many other economies. Some countries already have a reference dating of economic cycles, elaborated and updated by an institution independent of the government to avoid political interference. The United States was the first country to formally propose an official timeline of business cycle turning points, as early as 1978, by establishing a Business Cycle Dating Committee at the National Bureau of Economic Research (NBER),[2] currently composed of eight economists, whose role is to determine the entry and exit dates of U.S. recessions. This chronology of recessions, established by the NBER Dating Committee since 1854, is an authority among economists and serves as a reference for many empirical analyses. In Europe, the Center for Economic and Policy Research (CEPR) was inspired by the American experience and created in 2003 a dating committee, currently composed of five economists, to propose a chronology of business cycle turning points for the euro area.[3] Other countries, such as Brazil, Spain, and Canada, have also set up dating committees, but their audience remains relatively limited among the general public.[4]

Second, it turns out that many researchers need a baseline chronology to compare their results with the business cycle. For example, a reference dating is necessary for assessing the quality of leading indicators of the cycle, whether in terms of their accuracy or their "leading" character (Marcellino, 2006). In addition, dating makes it possible to classify economic indicators (leading, coincident, or

[1] See Section 2 for a literature review.

[2] https://www.nber.org/cycles/recessions.html

[3] https://eabcn.org/dc/news

[4] https://portalibre.fgv.br/en/codace, http://asesec.org/en/committees/spanish-business-cycle-dating-committee/ and https://www.cdhowe.org/council/business-cycle-council

lagging) for the reference cycle. Recession forecasting methods also require the use of a reference chronology to test the accuracy and optimal advance of predictions (Chauvet and Potter, 2005). Concerning macroeconomic studies incorporating a cyclical dimension, Bec and Ben Salem (2013) show the important role of inventories in cyclical dynamics during an economic recovery phase after a recession, based on a chronology of French cycles. Caggiano et al. (2014) use the dates of U.S. recessions from the NBER to calibrate the parameters of their non-linear model based on the frequency of occurrence of slumps. It is also useful to have a timeline of a country's cycles to conduct world cyclical comparisons in international economics. Assessing the timing of cycles across countries is thus often based on existing cycle dating (Puy and Monnet, 2016). The relationship between financial cycles and real economy cycles has recently been brought back into focus, in the wake of the Global Financial Crisis (see, for example, Adrian et al., 2019). Comparing these two types of cycles is frequently done using historical dating, following the example of the Bank for International Settlements (Borio et al., 2018).

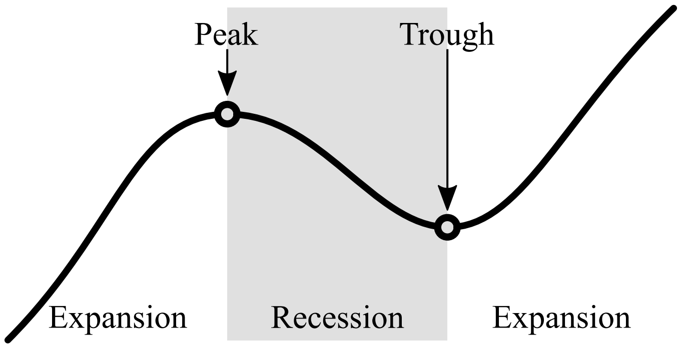
All in all, it seems essential to us that all those interested in economic cycles can rely on a common chronology of turning points for France, accepted by the broadest audience.

1.2 What type of business cycles does the Committee consider?

To carry out business cycle dating, it is first necessary to agree on the definition of the business cycle that we seek to identify. In this document, the Committee aims at establishing a historical chronology of the turning points in the French business cycle.

In defining the business cycle, we refer to the original work done at the NBER on descriptive methods of business cycles, particularly by Arthur Burns and Wesley Mitchell (1946), who defined concepts of cycles that are still used today. Simply put, the business cycle is the cycle in the level of economic activity. This cycle is defined as the succession of phases of increase in the level of activity, i.e., of positive economic growth (expansions), and phases of decline in this same level, i.e., of negative growth (recessions). These different periods are delimited by peaks (highest level of activity) and troughs (lowest level of activity) - corresponding to the turning points in the cycle - and are represented in Figure 1. The turning points thus refer to the alternation of peaks and troughs that delimit the phases of expansion (passage from a trough to a peak) and recession (passage from a peak to a trough) in economic activity. Burns and Mitchell (1946) also specify that "business cycles are a type of fluctuation found in the major aggregates of economic activity in a country [...]: a cycle consists of periods of expansion occurring at approximately the same time in several areas of activity followed by periods of recession...". This definition highlights two important characteristics of business cycles that are useful for implementing econometric approaches, namely (i) co-movement, which implies that the economic variables representative of the cycle move together throughout the cycle, and (ii) the existence of two distinct regimes of expansion and recession that may have different characteristics in terms of duration, amplitude, volatility, etc.

Figure 1 – **Diagram of the business cycle**



Note: Peaks and troughs correspond to business cycle turning points.

In the empirical literature on business cycles, there exist two other distinct concepts of economic cycle. On the one hand, the growth cycle, sometimes also referred to as the *deviation cycle* or the *output gap*, is the cycle that deviates from the long-run trend, originally introduced by Mintz (1969) in an NBER working paper. This long-run trend echoes the idea of a potential of an economy. The peak of the deviation cycle corresponds to the moment where economic growth falls below the trend growth (maximum of the *output gap*), and, symmetrically, the trough corresponds to the moment when growth goes over the trend growth (minimum of the *output gap*). This cycle can be estimated through many econometric and statistical approaches, but none of them seems to clearly dominate. This estimation is well known to suffer from an important bias due to edge-effects as the methods implemented to estimate the long-run trend are based on symmetric moving averages leading to some computational issues to estimate the last points (Orphanides et van Norden, 2002, or Hamilton, 2018). On the other hand, the acceleration cycle disentangles periods of increasing and decreasing growth rate of the economy, that is phases of accelerating and decelerating economic activity. The peak of the acceleration cycle represents the local maximum reached by the growth rate, and the trough marks the local minimum of this rate. This cycle possesses a higher frequency and is therefore useful for economists interested in short-term fluctuations. However, it also presents higher volatility, meaning that its dating and real-time monitoring are more complex. Anas and Ferrara (2004), Zarnowitz et Ozyldirim (2006), and Ferrara (2009) detail the characteristics of the growth and acceleration cycles and how they are related in the U.S. and the euro area.

The French Business Cycle Dating Committee has the only objective to provide a dating chronology for the French business cycle, that is to identify *ex post* the dates of recessions. In a first step, the Committee aims to determine this business cycle since 1970, on a quarterly basis.[5] In the future, the Committee will consider how to back-calculate this chronology and/or to estimate a monthly chronology.

[5]It is noteworthy that the Committee aims at providing a historical dating of recessions but neither at nowcasting recession in real-time nor at forecasting future recessions.

1.3 What is the methodology used by the Committee to identify recessions?

Dating business cycle phases is not an easy task, the main reason being that cycles are by nature unobservable. Therefore, they must be estimated using the various statistical and econometric approaches that have been put forward in the literature on the subject.

A simple characterization of recessions, often used by the media and the general public, consists of identifying a recession as soon as the GDP growth rate shows two consecutive quarters of decline. However, this so-called "two-quarter rule" is not sufficient to fully characterize a recession. First of all, in the existing chronologies for other countries, this rule sometimes does not coincide with the official dates. For example, the U.S. recession of 2001, linked to the bursting of the Internet bubble, would not be identified today by the "two-quarter rule". Moreover, although this rule may help date the beginning of economic recessions, it does not identify their end. More generally, this rule focuses only on one characteristic of the entry into recession and neglects other important attributes of cycles.

In particular, Burns and Mitchell (1946) characterize an economic recession as "a significant decline in economic activity in the various industries lasting more than a few months. This significant decline would normally be found in GDP, employment, industrial production, manufacturing and trade sales". Many academic studies have adopted this characterization of recessions (see, for example, Harding and Pagan, 2003), highlighting three main characteristics: duration, depth, and diffusion within the economy. This is the so-called "3D's rule"[6]. Duration indicates that a recession should last for several months. A minimum duration of six months is generally considered, hence the "two-quarter rule". But this condition must be combined with the other two, namely depth and diffusion within the economy. Depth, or amplitude, refers to the fact that two quarters with a very slightly negative GDP growth rate would not necessarily be considered as a recession. In contrast, an event that lasts only three months but has a very high amplitude, with significant macroeconomic consequences, could be accepted as a recession. The diffusion criterion refers to the idea that a recession must be widely diffused within the various components of the economy. This is why analysis of GDP alone is not sufficient to assess the occurrence of recessions. Other variables such as employment, industrial production, or household income must be integrated into the analysis process. In sum, it is the combination of the "3D's rule" criteria that will allow the Committee to estimate the dates of the recession phases. This approach also tends to avoid a mechanical revision of the dating based on the "two-quarter rule" during successive revisions of the GDP series.

Other characteristics of the business cycle have also been highlighted, such as the cycle's shape, e.g., more or less abrupt, or the asymmetric behavior of the phases - recession phases being shorter and more volatile than expansion phases. Several researchers have investigated whether the probability of a phase ending increases with time, i.e., whether the cycle has the property of duration dependence. Based on U.S. data since 1946, it seems that only recessionary phases exhibit this property (Diebold et al., 1993), although these results have recently been questioned (Beaudry and Portier, 2019).

The methodology that we have set up within the Committee for dating the cycles of the French economy is based on two pillars. The first pillar consists of measuring the French business cycle using econometric methods. First, we use non-parametric approaches that consist of identifying local

[6]Banerji (1999) has proposed the "3P": pronounced, pervasive, and persistent

maxima and minima in macroeconomic variables that are supposed to represent the business cycle. Then, we estimate parametric econometric models, generally non-linear, traditionally used in the empirical literature, such as threshold or Markovian regime-switching models. The second pillar relies on a narrative approach based on the opinion of the experts composing this Committee. This so-called "experts claim" filter is essential in this type of exercise because, although quantitative methods are a valuable aid to the decision that the Committee will ultimately take, their results cannot be taken directly into account without a thorough qualitative economic analysis. One of the reasons is that the results obtained are sensitive to the different specifications of the models or to the time period considered. The Committee that we have set up thus includes several profiles capable of integrating different dimensions into the narrative approach: historical, macroeconomic, cyclical, sectoral, econometric, etc. Based on these two pillars, quantitative measures and qualitative analysis, this approach appears to be the most suitable for this type of exercise.

1.4 How will this chronology be sustained by the Committee overtime?

It is important to emphasize that the Committee's work is primarily historical. Accordingly, we have chosen to date the cycles from 1970 to 2020, leaving the Committee free in the future to backdate this dating. It is, therefore, not the intention here to propose methods for identifying the beginnings and ends of recessions in real-time.

The Committee's purpose is not to provide a periodic assessment of the French economic cycles, but only to date *ex post* the entrances and exits of recessions. Consequently, the Committee will meet on an *ad hoc* basis, for example when it is necessary to date the beginning of an ongoing recession and/or to identify its end. However, the Committee is not precluded from conducting cyclical analyses during specific periods of interest.

The time lag between the announcement and the date of the turning point is variable and not fixed in advance. For example, the average delay for NBER announcements since 1980 is about 1 year, but peaks are identified more quickly than troughs, on average 7 months versus 15 months. Exceptionally, on June 8, 2020, the NBER dating committee identified February 2020 as the peak of the Covid recession. This particularly short time frame is related to the nature of the shock that caused this unprecedented recession. The asymmetry between the timing of recession and expansion announcements stems from the fact that there is always a risk of relapse or double-dip; the committee must therefore take more time to be sure that the economy is definitely out of recession. Indeed, if the economy relapses just after exiting a recession, it is legitimate to ask whether this is a new phase or a continuation of the previous episode.

In principle, a turning point dated by the Committee is not intended to be changed later. However, the Committee leaves itself some leeway on the subject because it is dependent on macroeconomic data that are revised over time by official data providers. Thus, the turning points for the current cycle, as well as those for the previous cycle, are considered as preliminary and may be revised over time. If the final dating coincides with the provisional dating, this will not attract the general public's attention, contrary to the case where differences occur. This approach is especially useful for dating troughs, which generally take longer to identify.

The remainder of this paper is organized as follows. Section 2 provides an overview of the literature on dating the French business cycles. Section 3 presents our estimates of the dating chronology based on various econometric, non-parametric and parametric approaches. Section 4 completes this quantitative analysis with a narrative approach. Section 5 concludes the paper by summarizing the selected dating chronology.

2 Review of the literature on the dating of the French business cycle

This section presents the different dating of the French business cycle available in the academic literature, as well as those provided by various institutions. The literature on the empirical analysis of business cycles highlights two main strategies for dating turning points: (i) so-called non-parametric approaches based on pattern recognition algorithms, and (ii) parametric approaches based on the estimation of econometric models.

2.1 Business cycle dating using non-parametric approaches

The traditional approach to cycle dating, initiated by the NBER, is based on the identification of peaks and troughs on level variables of interest, using pattern recognition algorithms capable of detecting the local maxima (peaks) and minima (troughs) of a cycle. Like the approach proposed by Bry and Boschan (1971), which is described in the following section, these methods focus sequentially on each phase of the cycle. They are called non-parametric, in the sense that they do not require the estimation of the parameters of an econometric model. From the initial identification of the turning points, we can estimate the various characteristics of the "3D's rule" to validate or not the cycles. Harding and Pagan (2002) propose an extension of this method to a quarterly framework, as well as other measures to evaluate the shape of recessions (concave or convex). In general, the series of aggregates from the national accounts are used, particularly GDP and business investment. Against a background of a monthly dating, industrial production, sales or household income series are also generally used.

As for the French business cycle, the dates obtained *via* non-parametric approaches are presented in Table 1. Damette and Rabah (2010) and Majetti (2012) applied the algorithm of Bry and Boschan (1971) on the GDP series to date the turning points from 1970 to 2009. They obtain similar dating and identify four recessions over this period: the first oil shock in 1974-75, the second oil shock in 1980, the 1992-93 crisis, and the Great Recession of 2008-09. This dating was proposed by Anas et al. (2007), who used GDP and industrial production series to estimate cycles in several European countries. The authors identify a peak in the cycle in 2002, unlike the two previous studies. The work of Cotis and Coppel (2005), conducted on a set of OECD countries, also reveals a recession in France from the third quarter of 2002 to the second quarter of 2003, which would have occurred in the wake of the American recession of 2001 linked to the bursting of the Internet bubble.

Two institutes located in the United States specialize in cyclical analysis and provide data for a large number of countries, updated regularly and available to the public. The Economic Cycle Research Institute (ECRI) was co-founded by Geoffrey Moore; it has long specialized in cyclical analysis and publishes data for 22 countries, both for business and acceleration cycles[7]. ECRI's methodology for identifying business cycle peaks and troughs is similar to that of the NBER, using non-parametric methods. The Conference Board is another institute known for its work on cycle analysis and detection, initiated by Victor Zarnowitz, in particular for producing leading and coincident indicators of a large number of economies. The Conference Board also publishes dates of recession and expansion phases for several countries.[8] Their approach is based on the Bry-Boschan algorithm. Both U.S. institutes tend to identify more cycles in France than other works, particularly a second recession in the 1980s, as well as a recession in 2002-2003 in the wake of the U.S. recession (see Table 1). Other European institutions, such as the ECB or Eurostat, have conducted work on the analysis of cycles in France (see Peersman and Smets, 2001; Mazzi and Savio, 2006), but without proposing an official dating.

These non-parametric approaches are simple and effective but have the disadvantage that they cannot simply be extended to a multivariate framework to capture the common movement in the business cycle. Two approaches can be implemented in this context to account for joint movement across a set of variables (see Stock and Watson, 2010, for a discussion). The first strategy, traditional at the NBER for tracking cycles, is to establish the timing of turning points across several variables and then aggregate these common dates (the so-called "date then average" strategy). The second strategy is based on the idea of first aggregating all the variables of interest into a single variable and then dating this aggregated variable. In this second strategy, known as "average then date", a standard assumption is that GDP is supposed to represent the evolution of the aggregate economy. An alternative is to construct an aggregate synthetic variable, for example by extracting a common factor from a large number of variables using a dynamic factor model that can be estimated by principal component analysis (PCA) or another method (see e.g. Doz et al., 2011).

For the French business cycle, the first strategy has not been used to date, at least to our knowledge. The second strategy has been implemented in line with Doz and Lenglart (1999)'s work on the construction of composite indicators. Thus, Cornec (2006) constructs a monthly GDP series for France using a multi-frequency dynamic factor model that integrates quarterly GDP and three other monthly variables (the industrial production index, salaried employment, and household consumption). Over the period 1985-2005, he identifies a single recession, from September 1992 to May 1993.

2.2 Dating cycles using parametric approaches

Several studies of the dating of cycles in the French economy use parametric econometric models, thus seeking to model the process that generated the data. These models have the particularity of being non-linear, capturing the fact that the economy evolves according to two regimes with different characteristics, expansion and recession regimes, and seek to model the transition from one regime to the other. The various existing models differ in the way the regime change occurs; it can be the result

[7]https://www.businesscycle.com/ecri-business-cycles/international-business-cycle-dates-chronologies
[8]https://conference-board.org/pdf_free/BusinessCycleReferenceDates.pdf

of a Markov chain or of a transition variable that is observable (see Section 3 for a formal presentation of the models).

Among these different models, the Markov regime-switching (MS, Markov-Switching) model, popularized by the work of James Hamilton (see, e.g., Hamilton, 1989), has proven its ability to faithfully replicate the U.S. business cycle (see also Charles et al., 2015). At the end of the estimation stage, the model provides a probability of being in one of the two growth regimes, for each point in time. When the probability crosses a given threshold (usually 0.50), this is interpreted as a turning point in the cycle. The first papers concern the American economy, but the first adaptation to French data was proposed by Rabault (1993) who estimated a MS model using the French GDP growth rate series. In general, only two regimes are considered, although the existence of a third regime may be useful in some cases (see for example Ferrara, 2003, for the U.S. economy).

Rabault's (1993) first work on French GDP from 1950 to 1990 (as well as on five other advanced countries) identifies only one recession since the first oil shock (see Table 2). The author highlights the estimation problems encountered with this type of model and indicates that the dating for France does not seem to "fit" well with the business cycle narrative. Damette and Rabah (2010) extend Rabault (1993)'s initial work by considering the period 1970-2009 and allowing for a structural change in the average growth rate from the third quarter of 1979. They highlight four periods of recession shown in Table 2, which appear consistent with the historical narrative. An interesting result of their study is the perfect correlation between the dating obtained *via* the Bry and Boschan (1971) method and the one obtained from the estimation of a Markov-Switching model.

Within this framework, other parametric approaches have been used to provide a dating chronology of the French business cycle. For example, Bec et al. (2015) propose an extension of the Markov regime-switching model that accounts for bounce-backs in growth out of recession before subsequently returning to a standard growth regime. This model identifies only the two recessions with the highest amplitude, namely the first oil shock and the Great Recession.

However, if one wishes to simultaneously take into account the co-movement between cyclical variables and the non-linearity of the phases of the business cycle, it is necessary to extend the analysis to a multivariate framework. This can be done using a regime-switching Vector Auto-Regressive model (MS-VAR, see Krolzig, 2001; Sims and Zha, 2006) or a regime-switching factor model (MS-DFM for Markov Switching Dynamic Factor Model, see Kim, 1994; Diebold and Rudedusch, 1996; Chauvet, 1998). Nguiffo-Boyom (2006) uses the latter specification for France by estimating a model with four variables from opinion surveys representative of the French cycle, namely personal production expectations, inventories in the manufacturing industry, and orders in construction and wholesale trade. The results are presented in Table 2. However, survey data are generally more suitable for describing the business cycle in real-time than for dating cycles, this latter exercise relying on real production or consumption data. Doz and Petronevich (2015) extend this approach to many variables and estimate several MS-DFM specifications. They compare dating chronologies obtained in one single step using a very small number of variables with ones obtained using a very large number of variables within a two-step approach. As a result they show they recommend the use of the second approach. The dating chronology extracted is presented in Table 2 and includes a large number of recession periods. The identified phases appear to be closer to the downturns in the growth cycle (i.e. cycle estimated by deviation to the long-term trend).

Although they are less popular than Markov regime-switching models for dating business cycles, some non-linear models, whose transition variable is observable, have also been used in this context. These include the Threshold Autoregressive (TAR) models used by Potter (1995) to model the growth rate of U.S. GDP, and the Smooth Transition AutoRegressive (STAR) models used by Teräsvirta and Anderson (1992). However, to our knowledge, there is no example of an application dating the French cycle.

Turning point chronologies of business cycles stemming from parametric models present a stronger variance than those obtained through non-parametric approaches. This reflects a larger sensitivity of the results to model specification, justifying thus the two-pillar strategy implemented by the Committee.

2.3 What are the dates of potential recessions in the literature?

From the various studies conducted on France, we can identify several recession periods that seem to be the subject of consensus between 1970 and 2010. It appears that four periods are common to all the estimates: the first oil shock of 1974-75, the year 1980, the crisis of 1992-93, and the Great Recession of 2008-09. Studies that extend beyond 2010 also tend to converge on the existence of another recession between 2011 and 2013, linked to the eurozone sovereign debt crisis. Other periods have been highlighted in some studies, such as the existence of a double-dip in the early 1980s or a recession in 2002-03 in the wake of the bursting of the Internet bubble in the United States. However, there is no consensus on these dates. In the next section, we present our quantitative measures of these potential recessionary periods, before proposing a qualitative assessment in Section 4, as part of our two-pillar identification strategy.

Note that other empirical works have been conducted on the dating of cycles in the French economy, but focusing on the growth cycle. Allard (1994), Fayolle (1993), and Portier (1994) are thus interested in the optimal way to extract this cycle *via* measures of the long-term trend. The OECD proposes a chronology of the turning points in this cycle for France and all OECD countries[9]. The leading indicators produced by the OECD thus seek to anticipate future turning points in this specific cycle, which differs from the business cycle.

[9]https://data.oecd.org/leadind/composite-leading-indicator-cli.htm

Table 1: **Dating chronologies for the French business cycle stemming from non-parametric approaches**

	DM	*Majetti*	*ABFL*	*CC*	*ECRI*	*TCB*
Peak	1974 Q3	1974 Q3	1974 Q3	1974 Q3	1974 M7	1974 M8
Trough	1975 Q1	1975 Q2	1975 Q1	1975 Q1	1975 M6	1975 M5
Peak	1980 Q1	1980 Q1	1980 Q1	1980 Q1	1979 M8	1980 M2
Trough	1980 Q4	1980 Q4	1981 Q1	1980 Q3	1980 M6	1981 M8
Peak					1982 M4	1982 M10
Trough					1984 M12	1985 M1
Peak	1992 Q3	1992 Q1	1992 Q1	1992 Q1	1992 M2	1992 M2
Trough	1993 Q1	1993 Q2	1993 Q1	2002 Q3	1993 M8	1993 M12
Peak			2002 Q4	2002 Q3	2002 M8	2002 M8
Trough				2003 Q2	2003 M5	2003 M5
Peak	2008 Q1	2008 Q1			2008 M2	2008 M2
Trough	2009 Q2	2009 Q1			2009 M2	2009 M8
Peak					2011 M4	2012 M2
Trough					2012 M11	2013 M4

Note : DM : Damette and Rabah (2010), data from 1970 to 2009 ; Majetti : Majetti (2012), data from 1970 to 2009 ; ABFL : Anas et al. (2007), data from 1970 to 2002 ; CC : Cotis and Coppel (2005), data from 1970 to 2003 ; ECRI : *Economic Cycles Research Institute*, dating updated in real-time from 1948 to 2020 ; TCB : *The Conference Board*, dating updated in real-time from 1945 to 2020. Shaded cells indicate the absence of dates for the study concerned.

Table 2: **Dating chronologies for the French business cycle stemming from parametric approaches**

	DM	*Rabault*	*BBF*	*NB*	*DP*
Peak	1974 Q3	1974 Q4	1974 Q3		
Trough	1975 Q1	1975 Q1	1975 Q2		
Peak	1980 Q1			1979 Q4	
Trough	1980 Q4			1980 Q4	
Peak	1992 Q3			1992 Q1	
Trough	1993 Q1			1993 Q1	
Peak				1995 Q2	1995 Q3
Trough				1995 Q4	1996 Q4
Peak					2001 Q1
Trough					2003 Q2
Peak	2008 Q1		2008 Q2		2008 Q2
Trough	2009 Q2		2009 Q2		2009 Q2
Peak					2011 Q3
Trough					2013 Q3

Note: DM : Damette and Rabah (2010), data from 1970 to 2009 ; Rabault : Rabault (1993), data from 1950 to 1990 ; BBF : Bec, Bouabdallah and Ferrara (2015) ; NB : Nguiffo-Boyom (2006), data from 1979 to 2005 ; DP : Doz and Petronevich (2015), data from 1990 to 2014 (we have dropped very short-term fluctuations identified by those authors). Shaded cells indicate the absence of dates for the study concerned.

3 Empirical approaches

In this section, we implement the first pillar of our strategy by proposing our estimates of the baseline dating based on econometric approaches. We first use a non-parametric approach and then estimate two types of non-linear parametric models.

3.1 Data

We use official data provided mainly by the French national statistical institute (Insee), available at the end of 2020. We focus on data sampled at a quarterly frequency, available over the period 1970 Q1 - 2020 Q2. In particular, we look at total Gross Domestic Product (GDP, in volume at previous year's prices, chained, seasonally adjusted, adjusted for working days), total employment (natural persons, total branches, number of employees in thousands, seasonally adjusted), the hourly volume of all jobs (salaried or not, total industries, number of hours (in millions), seasonally adjusted, adjusted for working days), investment by non-financial companies (total in volume at previous year's prices, seasonally adjusted, adjusted for working days), and the production capacity utilization rate (CUR, manufacturing industry, seasonally adjusted). The latter series comes from the quarterly business survey in industry and only begins in 1976 Q2.[10] From these variables, labor productivity is calculated as the ratio of GDP to the hourly volume of labor in all jobs. These variables are presented in Figure A1 in the Appendix. Note that other variables were tested, such as firms' margins or wages, but were not retained because the results were clearly not representative of the business cycle.

Other monthly variables are also used in this work for reference purposes. For example, we use the two monthly series of manufacturing output and industrial output excluding construction, which have been backcast to 1970 by the OECD (see Figure A2 in the Appendix). Other monthly series, such as retail sales or household consumption expenditures, have been tested, but they do not allow us to identify recessionary periods accurately over the whole of history.

France has a wealth of business cycle information from the business surveys conducted by Insee and it is tempting to assess the information content of these surveys. For comparison, we identify the turning points in the various surveys: industry, services, retail trade, construction, and the business climate indicator, which is a composite indicator of the various sectoral surveys (see Figure A3 in the Appendix).

[10]For the sake of precision, note that, although the CUR series is only available from the second quarter of 1976, the monthly business survey in the industry was first conducted by Insee in 1962. Moreover, as an opinion survey, the choice of the CUR may seem non-standard in view of the literature on the dating of cycles, but we show *ex-post* that the intensity of use of the productive apparatus is well related to the French business cycle. In general, the variables we have selected are representative of different sectors of economic activity and correspond to the same type of data as those used by the NBER and the CEPR.

3.2 Business cycle dating using non-parametric approaches

3.2.1 Methodology

We present below the core of the Bry and Boschan (1971) algorithm that we implement, knowing that we have seasonally adjusted series and outliers at our disposal. First, we determine a set of turning points on the series of interest, denoted Y_t hereafter, using the following rule that identifies local maxima and minima:

(i) Peak at date t if $\{Y_t > Y_{t-k}, Y_t > Y_{t+k}, k = 1, \ldots, K\}$

(ii) Trough at date t if $\{Y_t < Y_{t-k}, Y_t < Y_{t+k}, k = 1, \ldots, K\}$

where $K = 2$ for quarterly series and $K = 5$ for monthly series. Note that turning points cannot be identified 6 months before the end date.

Next, a procedure to ensure that peaks and troughs alternate is used based on the following rule:

(i) in the presence of a double-dip, the lowest value is chosen,

(ii) in the presence of a double peak, the highest value is chosen.

Once the candidate turning points have been identified, the duration and depth/amplitude criteria are evaluated. Duration means that the recession must last "more than a few months", as specified by the NBER in its original definition of a recession, without a theoretical minimum duration of reference. Therefore, we stick to the standard empirical durations according to which a phase of the cycle must last at least 6 months and a complete cycle at least 15 months. These minimum durations can be modified according to the nature of the series considered. For example, for a highly volatile and high-frequency series, the minimum duration of a phase may be increased.

The depth measures the fact that the recession must be a "significant decline in the activity", according to the original NBER definition. But again, there is no minimum amplitude that would indicate that the decline is significant. We will simply compare the depths of each recession, calculated as follows:

$$Depth = (Y_P - Y_C)/Y_P \tag{1}$$

where Y_P and Y_c are respectively the values of the level series at the peak and the trough of the cycle. To summarize the information of the duration and depth criteria, we propose a so-called "severity" measure, S, defined by :

$$S = |0.5 \times Depth \times Duration| \tag{2}$$

This measure provides a simple approximation of the cumulative loss of activity during the recession phase, in GDP points relative to the pre-recession level. This severity is also known in the literature as the *triangular approximation of cumulative movements*, as described for example in Harding and Pagan (2002).

The third criterion of the 3D's rule is the measurement of the diffusion of the candidate recession. Different measurement methods exist, especially when the number of variables considered is large, such as the calculation of a diffusion index, the computation of a concordance index (Harding and Pagan, 2002), or the simultaneous measurement of diffusion and synchronization among *n* variables proposed by Boehm and Moore (1984). In our context, given the small number of variables we consider (see Section 3.1), we simply evaluate this diffusion by counting the occurrences of recessions estimated on these different candidate variables.

A limitation of this approach is that it is difficult to conduct statistical inference since the distribution probabilities of the different measures (duration, depth, severity, diffusion) are unknown, and the number of observations is very small since 1970. We consider the estimated values of these measures as a basis for comparison for the different periods.

3.2.2 Results

First, we evaluate the recession phases from the GDP series by measuring the duration and amplitude of the cycles, the first two criteria of the 3D's approach. The identification of turning points is conducted *via* the standard Bry-Boschan approach, which imposes a minimum duration of two quarters for a cycle phase and a minimum duration of five quarters for a cycle (peak-to-peak and trough-to-trough). Estimation is carried out *via* the *BCDating* package developed in R, and results were also compared with those from the *@BryBoschan* procedure developed with WinRats 10.0.

The algorithm identifies five recession phases since 1970, with an average duration of 4 quarters (see Table 3). In terms of severity, we find that the Great Recession was the strongest of the dated recessions, more than twice as strong as the one linked to the first oil shock of 1974-75. The two periods 1980 and 1992-93 that were also identified are very similar in terms of severity. The signal for 2012 is less clear than for the other recessions. If we reduce the minimum duration to one quarter, the algorithm indicates a peak in 2012 Q1 and a trough the following quarter. However, the pattern for 2012 is as follows: a drop of the activity in Q2, followed by a rebound in Q3, but the level is still lower than the Q1 peak, and then again two-quarters of decline until 2013 Q1. Thus, the algorithm detects the 2012 Q1 peak but encounters a problem in identifying the trough because the 2012 Q2 level is lower than the 2013 Q1 level. It, therefore, returns 2012 Q2 as the trough. One proposal is to identify a peak in 2012 Q1 and a trough in 2013 Q1, which implies 4 quarters, albeit with very low severity. This type of double-dip recession makes identifying the entry and exit of a recession more challenging.

If we use this dating to plot the changes in the level of GDP over the three and a half years following the peaks of these expansion phases (Figure 2), we find that the Great Recession was by far the most severe. The pre-recession level of GDP was only recovered after three years, compared with six months to two years for the previous recessions. We also observe that the first oil shock was severe, but was followed by an extremely rapid recovery.

We then assess the diffusion of the phases by applying the same algorithm to the following four series: employment, hours worked, business investment, and capacity utilization rate. We observe in Table 4 that each recession identified from GDP is found on all these components, highlighting the diffusion

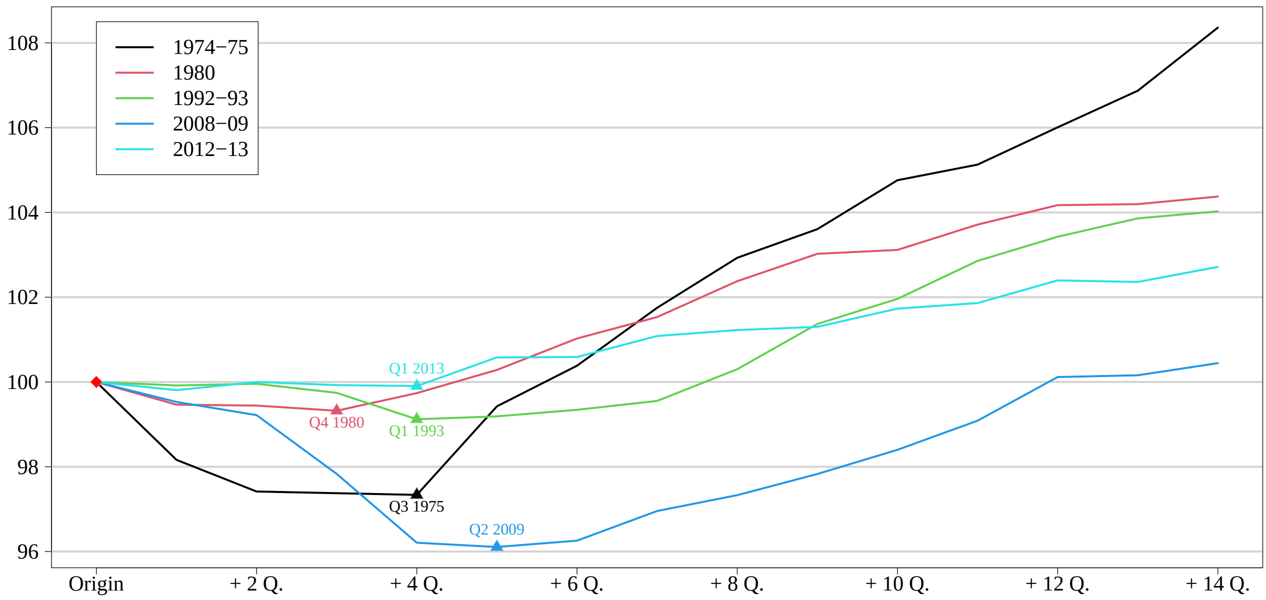
Table 3: **Dating of the GDP business cycle using a non-parametric approach**

	GDP	*Duration*	*Depth*	*Severity*
Peak	1974 Q3			
Trough	1975 Q3	4	-2.7	5.4
Peak	1980 Q1			
Trough	1980 Q4	3	-0.7	1.0
Peak	1992 Q1			
Trough	1993 Q1	4	-0.9	1.8
Peak	2008 Q1			
Trough	2009 Q2	5	-3.9	9.7
Peak	2012 Q1			
Trough	2013 Q1	4	-0.1	0.2
Peak	2019 Q3			

Note: Duration in quarters, Depth in %, Severity = | 0.5 × Duration × Depth |.

of recession phases. In particular, the 2012-13 recession, which seems very weak in terms of severity, is well diffused across the different components. On the contrary, we identify a downward phase on these four variables in the early 2000s, but this is not visible on GDP.

Figure 2 – **Evolution of the level of GDP after each peak of the expansion phases identified in Table 3 (base 100)**



Note : The triangle indicates the trough identified for each of the phases listed in Table 3.

We also consider the two monthly series of manufacturing output and industrial output excluding construction, which have been backcast to 1970 by the OECD. The results obtained by the Bry-Boschan detection algorithm are highly similar, the main difference being that the industrial production series provides an additional recessionary phase between 1976 and 1977. The turning points obtained on the manufacturing production series are presented in the last column of Table 4. This identifies nine recessionary periods in the industrial sector between 1970 and 2019, that is four more than in the economy as a whole. This is because the industrial sector is more volatile. After all, it is more sensitive to changes in the global economy. An industrial recession does not necessarily spread to the entire economy, as the example of the early 2000s shows. But when industrial and global recessions coincide, the turning points are generally relatively well aligned, even if industrial production tends to fall before the economy as a whole - this is sometimes referred to as an "industrial cycle".

We also identify turning points in the various Insee surveys: industry, services, retail trade, construction and the business climate indicator, which is a composite indicator of the various sectoral surveys. The variables present several mini-cycles, and to avoid identifying too many false signals, we increase the minimum duration of a cycle phase to 9 months. The results are shown in Table A1 in the Appendix. We observe that the surveys present numerous turning points that identify phases of economic activity that could be described as slowdowns, without necessarily corresponding to recessionary phases. It is interesting to note, however, that all the surveys mark the phases of recession identified in the previous quarterly variables. They are therefore useful for the monthly dating of cycles. In addition, they are generally earlier than the recession phases, particularly concerning the peaks of the cycles. This confirms the interest of this type of data to follow the phases of the cycle.

3.3 Business cycle dating using parametric models

In this section, we work on stationary time series, seeking to determine the peaks and troughs of the business cycle from the growth rates of five quarterly series. The quarterly growth rates of real GDP, total employment, labor productivity, investment, and capacity utilization rate are thus calculated from the series presented in Figure A1. The data end in 2019 Q4.

3.3.1 Threshold models

We consider here is a threshold autoregressive (TAR) model, augmented with a function that can capture a bounce-back effect of fairly general form (see Bec et al., 2014). Noting dx_t as the series representing quarterly growth rates, the TAR model with rebound effect, noted $BBF(p, m, \ell)$, is written as follows:

$$\phi(L)dx_t = \mu_t + \varepsilon_t \tag{3}$$

where L denotes the lag operator, $\phi(L)$ is a lag polynomial of order p, whose roots have a modulus greater than one, ε_t is a Gaussian white noise process with zero mean and variance σ^2, and μ_t is

Table 4: **Evaluation of the diffusion of recessions**

	GDP	*Employment*	*Hours*	*Investment*	*CUR*	*IP Manuf*
Peak			1971 Q1			
Trough			1972 Q3			
Peak	1974 Q3	1974 Q2	1973 Q4	1974 Q2		1974 M8
Trough	1975 Q3	1975 Q4	1975 Q2	1975 Q3		1975 M5
Peak			1976 Q3	1976 Q1		
Trough			1978 Q1	1976 Q4		
Peak	1980 Q1	1980 Q1	1979 Q4	1980 Q3	1980 Q1	1979 M8
Trough	1980 Q4	1980 Q3		1981 Q3	1982 Q1	1980 M10
Peak		1982 Q4		1982 Q2		1981 M12
Trough		1985 Q1	1985 Q4	1984 Q2		1983 M10
Peak	1992 Q1	1991 Q1	1990 Q1	1991 Q1	1990 Q2	1990 M2
Trough	1993 Q1	1993 Q3	1993 Q3	1993 Q4	1993 Q4	1993 M11
Peak			1995 Q3	1996 Q1	1995 Q3	
Trough			1996 Q2	1997 Q1	1996 Q4	
Peak		2002 Q4	2000 Q4	2001 Q3	2001 Q1	2001 M3
Trough						2001 M11
Peak						2002 M8
Trough		2003 Q3	2002 Q3	2003 Q2	2003 Q4	2003 M5
Peak					2004 Q4	
Trough					2005 Q4	
Peak	2008 Q1	2008 Q2	2007 Q4	2008 Q1	2007 Q4	2008 M4
Trough	2009 Q2	2009 Q4	2010 Q1	2009 Q3	2009 Q2	2009 M3
Peak	2012 Q1	2012 Q2	2012 Q1	2011 Q4	2011 Q4	2011 M5
Trough	2013 Q1	2012 Q4	2012 Q4	2013 Q1	2013 Q3	2012 M10
Peak			2014 Q1	2016 Q1		2013 M11
Trough			2014 Q4	2016 Q3		2014 M5
Peak	2019 Q3	2019 Q3	2019 Q4	2019 Q4	2018 Q1	2019 M5

Note: Capacity utilization rate (CUR) series starts in 1976. All series are quarterly, except manufacturing industrial production (*IP Manuf*) which is monthly.

defined as follows:

$$
\begin{aligned}
\mu_t &= \gamma_0(1-s_t)+\gamma_1 s_t \\
&\quad +\lambda_1 s_t \sum_{j=\ell+1}^{\ell+m} s_{t-j} + \lambda_2(1-s_t)\sum_{j=\ell+1}^{\ell+m} s_{t-j} + \lambda_3 \sum_{j=\ell+1}^{\ell+m} dx_{t-j-1}s_{t-j}
\end{aligned} \tag{4}
$$

Parameters (ℓ, m) correspond respectively to the delay with which the rebound effect is exerted and the duration of the latter. Parameters λ_i for $i = 1, 2, 3$, capture the existence and amplitude of the rebound phenomenon. The indicator function that governs the regime changes is defined by:

$$
s_t = 0 \text{ if } dx_{t-1} > \kappa \text{ and 1 otherwise,} \tag{5}
$$

where κ is the threshold, supposed to be negative or at least close to zero. This is indeed an asymmetric threshold model since the value of μ_t depends on the regime defined by s_t. We note that under the hypothesis H_0^N, according to which all the parameters defining the characteristics of the rebound effect are zero, i.e., $\lambda_i = 0$ for all i, the model given by Equations (3) and (4) boils down to a standard TAR model. Testing the hypothesis $H_0^N : \lambda_i = 0$, for all i, thus amounts to testing the existence of a bounce-back effect.

The originality of the model given in Equation (4) comes from the fact that it explicitly integrates a function aimed at capturing a bounce-back at the end of a recession. This function is general enough to encompass the forms of rebound that exist in this literature, namely U-shaped and V-shaped recoveries, and those that depend on the severity of the recession, known as D-shaped recoveries, as described in Kim et al (2005). In the general $BBF(p, m, \ell)$ model, the null hypothesis of linearity corresponds to $\mu_t = \mu$ constant, that is $\lambda_1 = \lambda_2 = \lambda_3 = 0$ and $\gamma_0 = \gamma_1$. Under this assumption, the threshold parameter is not identifiable: it is a nuisance parameter. This problem is well known in the literature on threshold models and the solution, proposed by Davies (1987) to test linearity, is to compute the *SupLR* statistics whose distribution is obtained by bootstrapping using the method suggested by Hansen (1996). If linearity is rejected, the presence of a rebound effect can then be tested by a simple likelihood ratio test of the H_0^N hypothesis whose statistics is distributed according to a Chi-2 distribution with three degrees of freedom. The test of the different forms of rebound, H_0^U, H_0^V, H_0^D, can then be carried out again using the likelihood ratio statistics, this time distributed according to a Chi-2 distribution with two degrees of freedom.[11]

Nonlinear least-squares are used to estimate the model $BBF(p, m, \ell)$. The number of lags p is selected as the lowest that removes any autocorrelation in the residuals. The parameters (ℓ, m) and κ are obtained by scanning in the following grids: $\ell \in \{0, 1, 2\}, m \in \{1, \ldots, 6\}, \kappa \in \{\kappa_L, \kappa_U\}$ where κ_L is the 5% quantile of the dx_{t-j} transition variable and $\kappa_U = 0$ so that the low regime effectively corresponds to a negative growth regime. The estimated values of these parameters are reported in Table A2 in the Appendix, which also contains the values of the *SupLR* test statistic and its associated probability (p-value column), calculated for 2000 random draws under the null hypothesis of linearity. As shown in the last column of Table A2 in the Appendix, the linearity hypothesis is strongly rejected for all the series studied. Therefore, we continue the analysis of the rebound effect by testing the various possible forms. To do this, we simply calculate the likelihood ratio statistics corresponding to the

[11]More precisely, H_0^U corresponds to $\lambda_1 = \lambda_2 = \lambda \neq 0$ and $\lambda_3 = 0$, H_0^V corresponds to $\lambda_1 = \lambda_3 = 0$ and $\lambda_2 \neq 0$, and H_0^D corresponds to $\lambda_1 = \lambda_2 = 0$ et $\lambda_3 \neq 0$.

null hypotheses on the parameters λ_i of Equation (4). Their values are presented in Table A3 in the Appendix.

The null hypothesis corresponding to the standard TAR model with no rebound effect is strongly rejected for all these variables. For the quarterly growth rates of total employment and capacity utilization, the BBD model - in which the recovery depends on the severity of the recession - is not rejected. This indicates that for these series, the recovery is all the more vigorous, the deeper the fall. The dynamics of the labor productivity growth rate can be represented by the BBU model, tracing a so-called “U-shaped” recovery. Finally, for the growth rates of GDP and real investment, only the parameter corresponding to the first term of the rebound function is significantly different from zero, and the BBU, BBV (“V-shaped” recovery), and BBD models are all rejected at the 1% threshold. This model in which $\lambda_2 = \lambda_3 = 0$ is denoted BBF_c.

The estimated coefficients of the selected models are given in Table A4 in the Appendix. For the regressions of total employment and GFCF (Gross Fixed Capital Formation), where the hypothesis of no ARCH effect up to order 4 is rejected at the 1% threshold, the standard errors were corrected following the method of Newey and West (1987), calculated with the Bartlett kernel. The estimated values of the parameters of the rebound function having the expected signs $\lambda_1 > 0,\ \lambda_2 > 0, \lambda_3 < 0$, there is indeed a rebound effect that corresponds to a value of μ_t higher than its average value of recession and then expansion.

Regarding the dating of cycles using these nonlinear threshold models, we adopted the following rule:

(i) Within the quarters classified in the recession regime by the model, we retain recessions with a minimum duration of 2 quarters.

(ii) In addition, quarters which, although not consecutive, are less than 4 quarters apart are grouped in the same recession.

The dates of the peaks and troughs of the business cycle obtained are presented in Table 5. Interestingly, the results for the GDP series strictly correspond to those from the non-parametric approach presented in Table 4 (except for the 2013 trough). In terms of diffusion to other variables, the episodes of 1974-75 and the Great Recession are diffused to all variables, reflecting the intensity of these two recessions. The 1992-93 period is also widely diffused among the variables, with only productivity remaining unaffected. The other phases seem to be less diffused. We also observe that the 2002-03 period is visible on most variables, without GDP appearing to be affected.

3.3.2 Markov-Switching models

We now estimate a Markov-Switching model (MS) classically employed in the literature on dating business cycles using particular models initiated by the work of James Hamilton (1990). By noting dx_t, $t = 1, \ldots, T$, the series representing the quarterly growth rates for the same five macroeconomic variables as before, the MS - AR(p) model with two regimes is written as follows:[12]

[12]We retain the standard assumption of two regimes that can be easily extended to a third regime (for example recession, low growth, high growth), especially for countries characterized by periods of low growth (see Ferrara, 2003).

Table 5: **Business cycle dating using a non-linear threshold model**

	GDP	*Employment*	*Productivity*	*Investment*	*CUR*
Peak	1974 Q3	1974 Q2	1974 Q3	1974 Q2	
Trough	1975 Q3	1975 Q2	1975 Q3	1975 Q3	
Peak				1976 Q2	
Trough				1976 Q4	
Peak	1980 Q1	1981 Q1			1980 Q3
Trough	1980 Q4	1981 Q3			1981 Q1
Peak		1982 Q4		1982 Q2	
Trough		1985 Q1		1983 Q2	
Peak			1986 Q3		
Trough			1987 Q1		
Peak	1992 Q1	1991 Q2		1992 Q2	1990 Q3
Trough	1993 Q1	1993 Q3		1993 Q2	1991 Q3
Peak				1996 Q1	
Trough				1997 Q1	
Peak					1998 Q3
Trough					1999 Q2
Peak		2003 Q1	2002 Q3	2001 Q3	
Trough		2003 Q3	2003 Q2	2002 Q2	
Peak			2006 Q2		
Trough			2007 Q1		
Peak	2008 Q1	2008 Q2	2008 Q1	2008 Q3	2008 Q3
Trough	2009 Q2	2009 Q3	2009 Q2	2009 Q3	2009 Q2
Peak	2012 Q1		2012 Q1		2011 Q4
Trough	2012 Q4		2013 Q3		2012 Q3
Peak	2019 Q3		2019 Q2		2019 Q2

Note: Capacity utilization rate (CUR) starts in 1976. Data used for estimation stop in 2019 Q4.

$$dx_t - \mu(S_t) = \sum_{i=1}^{p} \phi_i(S_t) dx_{t-i} + \sigma(S_t)\varepsilon_t \qquad (6)$$

where S_t is a random variable with values in $\{1, 2\}$, ϕ_i are the p autoregressive parameters depending on the regime S_t, $\sigma(S_t)$ is the standard deviation of the error term depending on the regime, and ε_t is a Gaussian white noise process with zero mean and unit variance. The full representation of the model requires the specification of the variable S_t as a two-regime first-order Markov chain, that is for each date t, S_t depends only on S_{t-1}, i.e.:

$$P(S_t = j|S_{t-1}, S_{t-2}, S_{t-3}\ldots) = P(S_t = j|S_{t-1} = i) = p_{ij} \qquad (7)$$

for all $i, j=1,2$. These probabilities are defined as the transition probabilities that determine the probability of changing regime between two dates or remaining in the same regime, such that $p_{i1} + p_{i2} = 1$. The estimation of the parameters is carried out *via* the EM algorithm proposed by Hamilton (1990). This estimation step also allows us to recover an estimate of the so-called filtered probability of being in a regime at each date t, $P\left(S_t = j|dx_t, \ldots, dx_1, \hat{\theta}\right)$, and an estimate of the so-called smoothed probability of being in a regime at each date t, $P\left(S_t = j|dx_T, \ldots, dx_1, \hat{\theta}\right)$.

To date the cycles, we assume that the low regime corresponds to a recession phase and the high regime to an expansion phase. Thus, the date t for switching from one regime to the other is assumed to be the turning point of the cycle. The decision rule for moving from one regime to the other is based on the choice of a threshold for the smoothed probability of being in a given regime. In general, the threshold of 0.50 is preferred in empirical studies but can be discussed.

In terms of model specification, we choose the smallest number of autoregressive lags that eliminates the first autocorrelations from the model residuals. In addition, for the GDP growth rate series, we include a dummy variable that is 1 from 1979 Q3 onwards and 0 before, similar to Damette and Rabah (2010), to account for a trend change in the level of GDP. For the labor productivity growth rate series, the introduction of a deterministic trend was necessary to clear the residuals of the MS model.[13]

Table 6 presents the results obtained from smoothed probabilities (i.e., using the information available over the whole period studied) of being in recession using a threshold of 0.50. The estimated coefficients of the selected models are given in Table A5 in the Appendix. Finally, the transition probabilities between regimes are reported in Table A6.

Overall, it seems that those models identify fewer cycles than the two previous approaches. Only the recessions linked to the first oil shock and the subprime crisis are detected for more than half the variables. The 1974-75 recession is indeed evident for all available variables since the capacity utilization rate series is only observed from 1976. The Great Recession that followed the subprime crisis is also identified for all five series, but it does not appear in Table 6 for labor productivity because it lasts only one quarter according to the estimation of the MS model (see Figure A4 in the Appendix). It thus appears that, on the French quarterly data since 1970, the Markov regime-switching models identify only the most severe recessions.

These models can theoretically be easily extended to several regimes and/or several variables in the

[13] On the productivity decline in France, we refer to Cette et al. (2017), Bellone (2017) or Askenazy et Erhel (2017).

Table 6: **Business cycle dating using a Markov-Switching model**

	GDP	*Employment*	*Productivity*	*Investment*	*CUR*
Peak	1974 Q3	1974 Q1	1974 Q3	1974 Q1	
Trough	1975 Q4	1976 Q1	1975 Q3	1976 Q4	
Peak			1980 Q1		
Trough			1980 Q3		
Peak		1981 Q1			
Trough		1982 Q4			
Peak		1988 Q2			1991 Q3
Trough		1992 Q4			1992 Q1
Peak		1997 Q3			1996 Q3
Trough		1999 Q1			1997 Q1
Peak			2006 Q2		
Trough			2006 Q4		
Peak	2008 Q1	2006 Q4		2008 Q1	2008 Q3
Trough	2009 Q1	2009 Q3		2009 Q2	2010 Q2

Note: Capacity utilization rate (CUR) starts in 1976. Data used for estimation stop in 2019 Q4.

framework of an MS-VAR (Krolzig, 2001; Sims and Zha, 2006) or an MS-DFM (Diebold and Rudebusch, 1996; Kim, 1994). However, our preliminary work has highlighted convergence problems of the estimation algorithm (see also Kim, 1994, on this issue) when working with a multivariate Markov regime-switching model on these quarterly French data. Further work can be done in the future to solve these issues. In particular, it may be interesting to test this algorithm using monthly frequency data or to rely on a two-stage estimation method (Doz and Petronevich, 2015).

3.4 A brief summary

The econometric estimates carried out above highlight six periods that could be identified as recessions. Among these, four episodes stand out more particularly: the two oil shocks of 1974-75 and 1980, the 1992-93 crisis and the Great Recession of 2008-09. Two other periods are also worth considering. First, the 2012-13 period, associated with the euro area sovereign debt crisis, appears to be well diffused across all variables but has very low severity compared to other recessions. Second, the 2002-03 period, which follows the bursting of the Internet bubble in the United States, is also diffused within certain variables but is not visible on GDP.

4 Evaluating candidate recessions using a narrative approach

In this section, we implement the second pillar of our strategy, which is based on a narrative approach using experts claims. This approach allows us to validate the periods identified as recessions by the previous econometric analysis in terms of the economic situation prevailing during the episodes under consideration, without necessarily modifying the dates of the peaks and troughs. We thus review the different possible periods of recession to determine our reference chronology. Finally, while four episodes (1974-75, 1980, 1992-93, and 2008-09) are identified as recessions, we consider that the periods 2002-03 and 2012-13 are more akin to economic slowdowns. Furthermore, we acknowledge the fact that the Covid-19 pandemic recession began in the first quarter of 2020.

4.1 Identified periods of recession

4.1.1 Oil shocks of 1974-75 and 1980: from the roots of evil to the lost magic square

Our identification of recession periods in 1974-75 and 1980 remains relatively classical concerning the dating work presented in Section 2. If we are nuanced in our analysis, it is not out of caution but out of conviction. A series of factors converged and caused a chain of cumulative downward effects.

The economic crisis of 1973, regularly referred to as the oil crisis, had significant consequences for the French economy. The years 1974-75 were marked by a decisive break with the boom of the golden decades of the 1950s and 1960s, which were known for rapid growth, price stability, high employment, and, more generally, confidence in the future.

The shock of 1974, initially interpreted as a passing phenomenon, if not a “bad moment”, led to the deepest recession since the 1930s observed up to that point. The cause generally cited was the monetary instability that resulted from the death of the Bretton Woods system, the monetary system set up at the end of the Second World War based on a general regime of fixed exchange rates managed under the jurisdiction of the International Monetary Fund (IMF). The devaluation of the U.S. dollar and the revaluation of the German mark in 1973 led France to adopt a floating exchange rate regime.

However, this was only a trigger, as many other factors were at play, such as the relative decline in investment observed since the early 1970s. There was also a sharp rise in wages, following the 1968 strikes and the Grenelle Agreements. The early 1970s were also marked by a sharp increase in the price of raw materials: first of all, cereals (mainly wheat in 1972), but above all certain primary products (copper, wood, phosphates, etc.), and finally the quadrupling of the price of oil between October 1973 and early 1974.[14] These price increases led to accelerated inflation, measures to stabilize and defend the national currency, and, obviously, a collapse in investment activity and, soon after, in (industrial) production itself. In addition, inflation has reduced the purchasing power of households while encouraging them to increase their savings, mainly for fear of unemployment. As for companies, they are victims of a significant drop in activity (fewer profit margins and debts to be honored), correlated with a limited investment capacity.

[14]In 1973, France imported about three-fourths of its energy requirement and covered about two-thirds of its consumption by petroleum products.

Thus, France suffered a particularly significant drop in activity in the last quarter of 1974 and the first quarter of 1975. To combat stagflation, fiscal and monetary interventions, stop-and-go policies, were aimed first at fighting inflation with a cooling plan, the Fourcade Plan of 1974, before correcting the effect of worsening unemployment with the Chirac stimulus of 1975, which amounted to 2.3 points of GDP. But the virtuous circle very quickly turned into a vicious circle. Thus, in September 1976, when France was forced to leave the monetary snake (it rejoined it in December 1978), the Barre plan gave priority to the fight against inflation, believing that fighting rising prices also meant fighting unemployment.[15]

Economic policy was aimed at a return to the market as a guarantee of competitiveness. The French government then embarked on lowering the tax burden in line with the liberal option to guide its action. Although less intense than the 1974-75 recession, the one that began in 1980 was no less significant. In its own way, the second oil shock of 1979 had similar effects to that of 1973. Both domestic and foreign demand slowed down. In foreign markets, companies tended to squeeze their margins, while raising prices in the domestic market. The automobile, textile, and construction industries were among the sectors most affected by a downward trend, despite the implementation of expansionary policies introduced after the 1981 elections: monetary adjustment and defense of the franc, credit controls, price, and wage freezes. While the achievement of the magic square - strong growth, high employment, price stabilization, and external trade balance - remained the objective, the recession of the early 1980s also brought new challenges, including the close interweaving of economic and social progress (social security, unemployment, etc.).

4.1.2 The 1992-93 investment cycle or how to turn a strong slowdown into a recession

The 1992-93 recession illustrates how the end of an investment cycle can turn into a contraction of activity when this end of the cycle is accompanied by a monetary policy out of sync.[16]

At the end of the 1980s, the French economy was experiencing a remarkably sustained expansion phase, with a growth of over 3% for three consecutive years. This was driven mainly by business investment spending, which rose by more than 8% per year from 1988 to 1990. Market employment itself grew by more than 2% per year, allowing the unemployment rate to fall by one percentage point between 1987 and 1990, and household income purchasing power to increase by nearly 4% per year. This phase was made possible by a loosening of both monetary policy (particularly in the United States, to counter the recessionary risks arising from the 1987 stock market crash) and fiscal policy (thanks to the substantial tax revenues associated with the return to growth). Economic policies had thus played a *de facto* pro-cyclical role during the expansionary phase. The same thing happened in the next phase, but in the opposite direction, with monetary policy accentuating the downturn of the activity.

[15]The Barre plan also includes the restoration of external balance, through the strengthening of the currency. More generally, it should be noted that this plan illustrates the combination of cyclical and structural factors that characterizes French economic policies over the long term. Thus, the anti-inflation policy is linked to the immediate concern to reduce the inflation differential with Germany (cyclical dimension), but also to reflections on corporate debt policies (structural dimension).

[16]On this recession, see the "Cycle" dossier presented to the *Commission des comptes et des budgets économiques de la Nation* in June 1994 (Insee, 1994), and L'Horty and Tavernier (1995).

At the beginning of the 1990s, the economic cycle moderated, particularly in the Anglo-Saxon countries, as the real estate boom ended. GDP contracted in the United States in 1991, and the recession in the American economy spread its slowdown effects to its partners. Faced with this slowdown, companies in France put the brakes on their investments in 1991, and market employment stagnated that same year. The decline in unemployment thus came to a halt, which led to a sudden rise in household savings and stagnation in consumption from 1991 onwards. The increase in household savings (whose share of income rose from 11.4 to 14.3% between 1989 and 1992) was also fueled by a rise in interest rates that occurred at the wrong time, given the end of the expansionary phase of the business investment cycle. In 1992, when the economic slowdown was already evident, three-month real interest rates were raised to 8.4% from 6% in 1989 when growth was 4.5%, which also contributed to the decline in real estate prices.

The rate movements that took place at the time should be seen in a very specific international context. Faced with an economic recession and the bursting of a stock market bubble respectively, the United States and Japan drastically lowered their interest rates (-450 and -300 basis points respectively between 1989 and 1992). Conversely, in the wake of reunification and the demand boom that followed with the 1:1 conversion of the East German currency into the Deutschmark, Germany saw inflation accelerate significantly. It was 3.6% and then 4% in 1991 and 1992. The German three-month nominal rate was raised by 240 basis points between 1989 and 1992. In so doing, the mark appreciated, dragging along the European currencies that were pegged to it within the European Monetary System (EMS). Between 1989 and 1992, the franc appreciated by more than 20% against the dollar. These currency tensions erupted with the successive devaluations of the pound, the lira, the peseta, and the escudo. The franc was attacked and, although the band of fluctuations against the mark was widened, the devaluation was avoided by raising short rates to over 12% in early 1993.

Business investment, which was already faltering before the currency turmoil, could not withstand this and collapse by 7% in 1993. Businesses also cut back on inventories to preserve their cash flow, while market employment fell by 1.5% and unemployment rose by two percentage points compared with 1990. Household consumption stagnated as a result, and GDP fell by 0.6% in 1993. A supportive fiscal policy in 1993 and gradual easing on the monetary front gradually restored some room for maneuver, but it was not until the end of 1996 that market employment returned to the level it had been before the 1992-93 slowdown and then the recession.

4.1.3 The Great Recession of 2008-09: a cost shock over-amplified by the global financial crisis

The 2008-09 recession bears several striking similarities to the 1992-93 recession. An economic downturn was already underway before the recession. It stemmed from the major drain on purchasing power caused by the rise in the price of most raw materials, related to the explosion in Chinese growth (+12% per year from 2004 to 2007). In Europe, key interest rates were still on the rise, even though the slowdown had already begun. As in 1992-93, the latter turned into a deep recession following the liquidation of Lehman Brothers, which triggered a veritable financial conflagration. The monetary and financial system froze, and a crisis in access to liquidity led to a sudden collapse of the activity, particularly in the industrial sector, which was confronted with the halt in world trade from the autumn of 2008 onward. Unlike the 1992-93 recession, the 2008-09 recession was not French or European in the strict sense of the word but was part of a global concert. It differs even more from its predecessor in its scale. The decline in GDP between its peak and trough was more than four times greater in 2008-09 than it had been sixteen years earlier (-3.9% compared with -0.9%, see Table 3, Section 3).

The 2008-09 recession followed four consecutive years of exceptionally strong global growth (5% on average from 2004 to 2007). Fueled by unbridled credit expansion, it was built on growing global current account imbalances, where the U.S. current account deficit was offset by growing surpluses in the Chinese economy, among others. These surpluses were recycled back to the U.S., helping to keep interest rates relatively low and feeding the appetite for debt for real estate investment through unbridled financial innovation. The U.S. housing market collapsed from the end of 2005, triggering a domino effect that culminated in the liquidation of Lehman Brothers. The downturn in the global economic cycle started in the United States, which entered a recession in December 2007 according to the NBER, and was reflected in a contraction in European GDP from the spring of 2008.

This initial decline in activity was mainly a consequence of the loss of purchasing power caused by the surge in energy and agricultural commodity prices. This price boom continued until the summer of 2008 when the oil price temporarily exceeded 140 U.S. dollars per barrel (a fourfold increase since 2003). Before giving way to a sharp relapse, this sudden rise had, in the meantime, led to a reduction in the purchasing power of household income, pressure on the level of corporate margins in importing countries, and, ultimately, a restriction on spending by private agents. In this context marked by the exacerbation of scarcity, fears of a resurgence of inflationary pressures peaked in the summer. This led to a rise in key rates in Europe, but not in the United States, which was already in recession. This increase contributed to further strengthening the euro against the dollar, bringing it to 1 euro for 1.60 dollars at its peak in mid-July 2008.

The sudden downturn of the activity, coupled with the amplification and exacerbation of the financial crisis, dispelled inflationary concerns and replaced them with fears of a return to deflation. The financial market turbulence that began in the summer of 2007 turned into a deep crisis in the banking and financial system, which amplified the recessionary mechanisms already at work. The shockwave from the Lehman Brothers bankruptcy in September 2008 affected all asset classes. The flight to liquidity and the generalized climate of mistrust led to a freeze in the interbank market, prompting massive and multi-faceted interventions by the monetary authorities. The announcement of support plans for the financial sector on both sides of the Atlantic and the Pacific allowed the situation on the money markets to ease somewhat, but it took time before the credit channel was able to function again. The mechanisms put in place to support activity (lower interest rates, lower commodity prices, and fiscal activism) gradually began to have an impact from the spring of 2009.

The recession of 2008-09 was because the limits of the combination of a sharp rise in debt and asset prices had been reached. The year 2009 had thus opened a phase of the search for a new model of sustainable growth, but also initiated a movement of deleveraging that was to culminate - only - in Europe from 2011 with the turn towards strong fiscal consolidation that was to bring the French economy to the edge of recession. The sequence of events in Europe, in general, and in France, in particular, meant that the level of market employment that had been reached at the peak of activity before the 2008 recession was not to be regained until eight years later in the summer of 2016.

4.1.4 The health shock of 2020

The Covid-19 pandemic sent the world economy into one of the most severe crises in its recent history, totally unprecedented in its scope and nature. In France, the decrease in GDP was 8.2% on average per year in 2020 according to the results of the quarterly accounts published at the end of February 2021 by Insee, and activity had declined by almost 20% between the fourth quarter of 2019 and the second quarter of 2020. This economic recession is the consequence of three major shocks that have almost simultaneously affected most countries. The prophylactic measures put in place have generated a double shock to supply and demand: on the one hand, the population containment measures have severely constrained consumption, weighing in particular on the service sector, and on the other hand, they have exerted strong constraints on the production process, forcing companies to adapt to new conditions dictated by health security measures. In addition, domestic supply shocks have spread through global supply chains, with disruptions depriving some firms of the inputs they need for production.

Finally, at the peak of the crisis, the world economy experienced a shock of the uncertainty of great magnitude. This is the first time in recent history that such a high level of health stress has affected all countries over the world. This radical uncertainty is reflected in the inability of economic agents to anticipate events, leading to postponed initiatives from households and companies. While such behavior may lead to precautionary savings, most of the observed increase in savings is explained by the combination of an income level maintained by support measures and consumption prevented *de facto* by prophylactic measures (closure of shops and activities, travel restrictions, etc.). By way of illustration, according to the national accounts at the end of April, household purchasing power increased slightly, on average over the year 2020 (+0.2%), while consumption fell by -7.0%, bringing the savings rate of French households to 21.0% of their disposable income in 2020, compared to 14.9% in 2019.

Given the nature of the original shock, the first quarter of 2020 can be identified as the start of the Covid-19 recession. The last quarter of 2019 is then the peak of the business cycle. However, the estimation of the models presented in Section 3 shows that the last quarter of 2019 should technically be considered as the first quarter of recession. It should be noted, nevertheless, that this quarter is marked by the public transport strikes that weighed on the French economy. For this reason, it seems more appropriate to us to identify the first quarter of 2020 as the one marking the start of the Covid-19 recession, with the peak thus having taken place in the last quarter of 2019. At this point, it is still too early to make a reading of the Covid-19 recession based on the business cycle.[17]

4.2 Periods considered as economic slowdowns

Beyond the four periods of recession we have just identified, two other periods are considered to be economic slowdowns, without being characterized as recessions.

[17] Let us mention here the debate about the nature of the current crisis, which can be considered either as a recession or as an "outlier". Our work supports the first interpretation, as the Covid-19 crisis constitutes an unprecedented external shock with major macroeconomic effects.

4.2.1 The slowdown of 2002-03: from the bursting of the Internet bubble to competitive disinflation policies

During the period 1997-2000, the French economy fully benefited from the acceleration of world growth, boosted in particular by the New Information and Communication Technologies (NICT) sector and the introduction of the single European currency. With an average annual growth rate of more than 3%, France's performance matched the peaks observed ten years earlier and was more than one percentage point higher than that recorded at the same time in Germany and Italy. France's trade balance showed large surpluses (2.5 points of GDP on average, compared with 1.2 points for Italy and a deficit of 1.2 points for Germany), while its unemployment rate fell steadily and significantly, by 3 points of the active population,[18] its sharpest decline in the post-oil shock era (compared with nearly 2 points in Germany and Italy).

But this global growth was unstable, driven among other things by "irrational market exuberance" which overestimated the value of "new economy" companies, particularly in the United States, and by very low interest rates. Following the rise in interest rates at the end of 1999, the dot-com bubble burst in March 2000, causing the NASDAQ to collapse and spreading to all stock markets. The new technology sector then entered a recession, while the rest of the economy was affected by strong wealth effects due to large asset depreciation. Global growth suddenly collapsed from almost 5% in 2000 to 2.4% in 2001 and 2.9% in 2002.

This shock to global demand was combined with a triple shock to the competitiveness of the French economy. The first is associated with the euro exchange rate. Introduced in 1999, the European currency, which traded at a rate of one euro for 1.18 dollars on January 1, 1999, saw its rate fall to one euro for 0.85 dollars in October 2000. However, from that date on, the euro appreciated sharply, reaching over 1.05 dollars at the end of 2002 and its initial value at the end of 2003, thereby reducing the competitiveness of European and French products.

The second shock is linked to China's entry into the World Trade Organization (WTO) in December 2001. China entered as the sixth-largest exporter, accounting for 6% of world exports of goods. While maintaining control over its industrial and exchange rate policies, it quickly gained market shares over its partners, and by 2010 had become the world's largest exporter, accounting for 15% of world exports.

Finally, during this period, Germany, which initially had a foreign trade deficit, embarked on a competitive devaluation strategy. This was based on a far-reaching reform of the labor market, which allowed companies to use an internal adjustment strategy in the face of a shock by acting on wages and working hours and by lowering social security contributions, particularly on new hires.[19]

As a result of this triple shock, France's external position deteriorated between 1997 and 2003, albeit to a lesser extent than that of Italy or Spain - each of which lost more than 3 percentage points of GDP - but significantly (1.9 percentage points of GDP). Against a background of a weak international context, but supported by still dynamic household consumption, France avoided the recession of the

[18] This drop in unemployment was so significant and regular that some reports spoke of full employment in France shortly (Pisani-Ferry, 2000).

[19] We refer to Dustmann et al. (2014) for more details.

economy as a whole, unlike Germany or Italy, but experienced a recession in its industrial sector and a generalized slowdown until mid-2003 (see also Adanero-Donderis et al., 2009).

4.2.2 The 2012-13 slowdown: from austerity to monetary "whatever it takes"

At the beginning of 2011, three years after the bursting of the subprime bubble, France, like Germany and the United States, had returned to its pre-crisis level of activity, while the United Kingdom, Spain, and Italy were still 3 to 5 GDP points behind their 2008 levels. But, unfortunately, the first half of 2011 saw the recovery process initiated two years earlier come to a halt: due to the shift in European budgetary policies towards austerity, the French economy entered a phase of stagnation, without however falling into recession.

The euro area as a whole was affected by this second phase of slowdown and then found itself outpaced by the United States. At the end of 2013, the U.S. economy had a level of economic activity far above that of before the crisis (+6.1 GDP points), whereas Germany had to make do with half (+3 points) and France even half as much (+1.5 points). However, this mediocre French performance can be put into perspective: for the euro area as a whole, the output gap was estimated to be negative at that time, about 2.5 points. So it was not France that had fallen behind its main European partners, but rather Europe that had become the "sick pupil" of the world economy.

Thus, during the years 2011-13, macroeconomic policies in France and the rest of the eurozone, whether fiscal,[20] monetary, or exchange rate,[21] weighed heavily on European and French growth. The effects of these policies were all the more recessionary (i) because they were applied while the economy was still bearing the scars of the recession (high unemployment, for example), (ii) because they were carried out systematically in all European countries, and (iii) because a strategy of gradual and smooth fiscal consolidation was replaced by a strategy of rapid and aggressive reduction of public imbalances.

On the positive side, however, the major international institutions and monetary authorities have become aware of this manifest error in economic policy. On the fiscal policy side, the most notable development was the IMF's *mea culpa* in January 2013. The international institution admitted that it had underestimated the effect of the eurozone's austerity policies on growth by more than 100% during that period (Blanchard and Leigh, 2013). In their paper, the two economists conclude that "it seems prudent, for the time being, when thinking about fiscal consolidation, to assume that multipliers are higher than before the crisis"; this is tantamount to saying that the impact of fiscal consolidation on unemployment will be large while the reduction in government deficits will be small. Many other studies have confirmed this result and from now on, including for the European Commission, the return to balanced public finances must be carried out in a more coordinated, less systematic way and accompanied by a more accommodating monetary policy. The latter has also seen a turning point: on July 26, 2012, eight months after taking office as head of the European Central Bank (ECB), Mario

[20] In France, this resulted in an increase in compulsory taxes of more than 2.2 points of GDP during this period, after 1.2 point in 2011.

[21] At 1.38 U.S. dollars at the end of 2013, the value of the euro increased by 12% against the dollar, by almost 50% against the yen, and by 6% against the pound sterling in the space of 18 months, worsening the price competitiveness of euro area countries.

Draghi, succeeding Jean-Claude Trichet, in front of an assembly of investors in London, announced that the ECB would do "whatever it takes" to preserve the euro. With those three words, the European central banker sent the signal that European monetary policy was changing course. Since then, the ECB has finally taken on the role of lender of last resort,[22] like its American, British, and Japanese counterparts, to protect peripheral countries from bankruptcy and thus to relieve market pressure.

Taking all these elements together, it is clear that the 2012-13 period is particularly complex because the signals are not unambiguous. On the one hand, the fact that the euro area as a whole suffered this economic slowdown and that it spread to the various variables considered (Table 4) tends to argue that this episode should be considered a recession. On the other hand, the weakness of the contraction of GDP during this period - the estimated severity is close to zero, by far the lowest among other candidate recessions (see Table 3) - and other factors such as the increase in public sector consumption and the moderate level of inflation[23] - which limited the loss of purchasing power - tend to qualify and counterbalance this picture. All in all, and in line with the weakness of the second "D" in the 3D's rule, even if this period is characterized by a marked slowdown in growth in France, we do not consider that the economy tipped into a recessionary regime in 2011-13.

5 Conclusion

Having a reference chronology of turning points in the French business cycle is a useful public good for many economists and researchers. The NBER in the United States and the CEPR in Europe have made such a timeline available for the U.S. economy and the euro area, respectively. With this in mind, in October 2020 we created the French Business Cycle Dating Committee whose objective is to provide a historical chronology of the expansion and recession phases of the French economy since 1970, but also to maintain this reference chronology over time.

This article presents the procedure used by the Committee to construct this quarterly dating. The methodology used is based on two pillars: (i) a detailed econometric work using various key data to identify and date candidate recessionary periods, and then (ii) a narrative approach that details the economic background of the time to finalize our estimate of recessionary episodes.

Over the period from 1970 to the present, the Committee has identified four phases of economic recession, with an average duration of one year, compared with about 10 years for expansionary phases[24] (see Table 7 below): the two oil shocks of 1974-75 and 1980, the investment cycle of 1992-93, and the Great Recession of 2008-09 triggered by the financial crisis. The recent peak of the Covid recession has been dated to the last quarter of 2019. Determining the exit date from the Covid-19

[22]This resulted in (i) the creation of a mechanism for unlimited purchases of debt securities of countries in difficulty (Outright Monetary Transactions) in exchange for a loss of budgetary sovereignty to the Troika (ECB, European Commission, IMF); (ii) then by massive long-term loans to banks, the TLTROs (Targeted Long Term Refinancing Operations); (iii) finally, following the example of the U.S. Federal Reserve or the Bank of Japan before it, by implementing a "Quantitative Easing" (QE), i.e., a massive plan to buy government debt in the spring of 2015.

[23]According to OECD data, government collective (resp. individual) consumption expenditure thus increased from 8.37% (resp. 15.37%) of GDP in 2011 to 8.48% (resp. 15.47%) in 2012 and 8.54% (resp. 15.57%) in 2013. As for the inflation rate, it was 2.11% in 2011, 1.95% in 2012 and 0.86% in 2013.

[24]The average duration of an expansion phase since 1970 is 41 quarters, compared with 4 quarters for a recession phase.

recession, which is unprecedented in its shape and profile, will likely require the forging of an *ad hoc* doctrine. As one of the objectives of the French Business Cycle Dating Committee is to keep our cycle-dating chronology up to date, we invite you to visit the AFSE[25] website for future updates.

Table 7: **Recession dates in the French economy selected by the Committee**

	Selected dates
Peak	1974 Q3
Trough	1975 Q3
Peak	1980 Q1
Trough	1980 Q4
Peak	1992 Q1
Trough	1993 Q1
Peak	2008 Q1
Trough	2009 Q2
Peak	2019 Q4

[25]https://www.afse.fr/fr/cycles-eco-500215

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APPENDIX

Figure A1 – **Quarterly macroeconomic variables used since 1970**

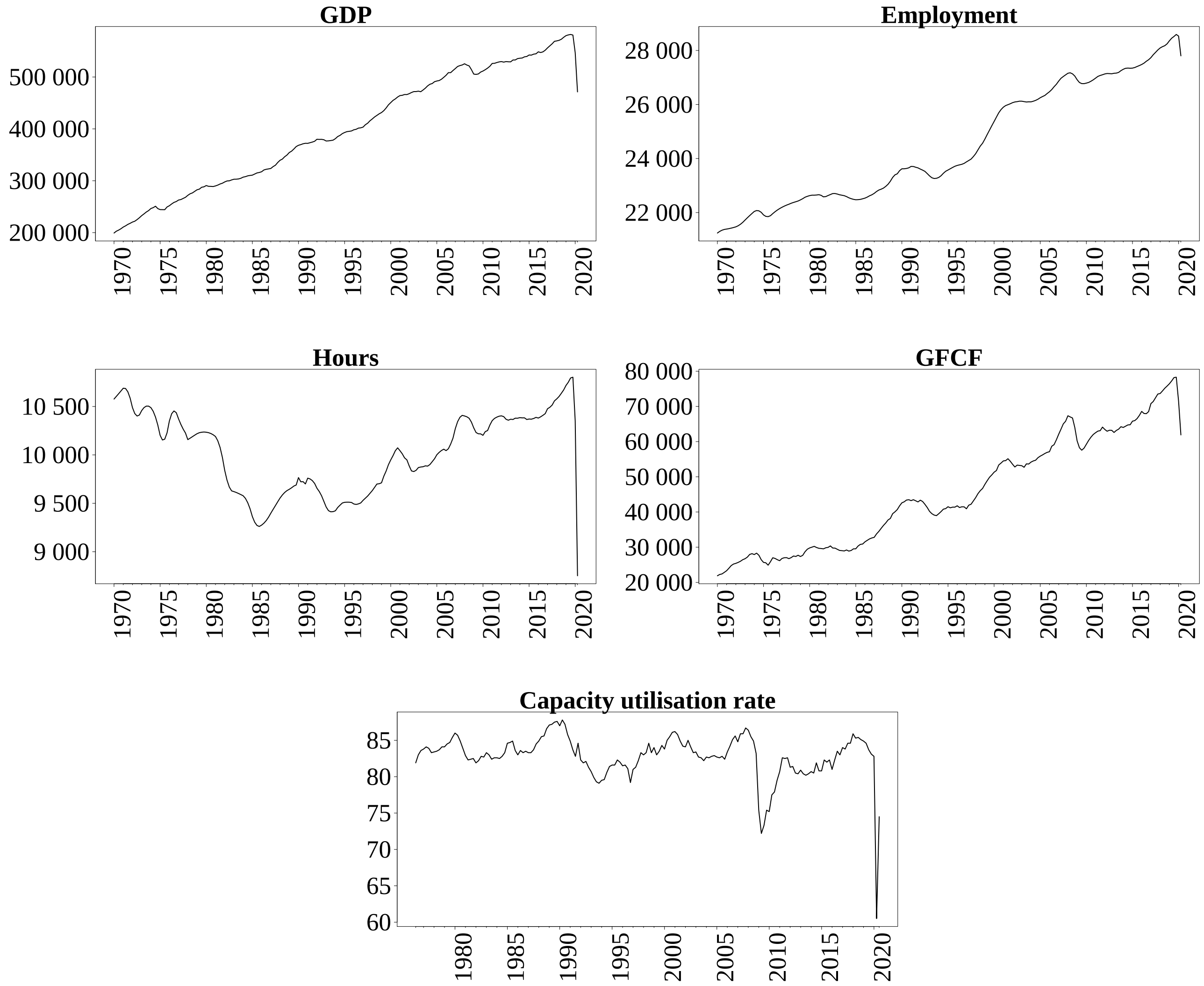

Figure A2 – **Monthly macroeconomic variables used since 1970**

Manufacturing production index

Industrial production index

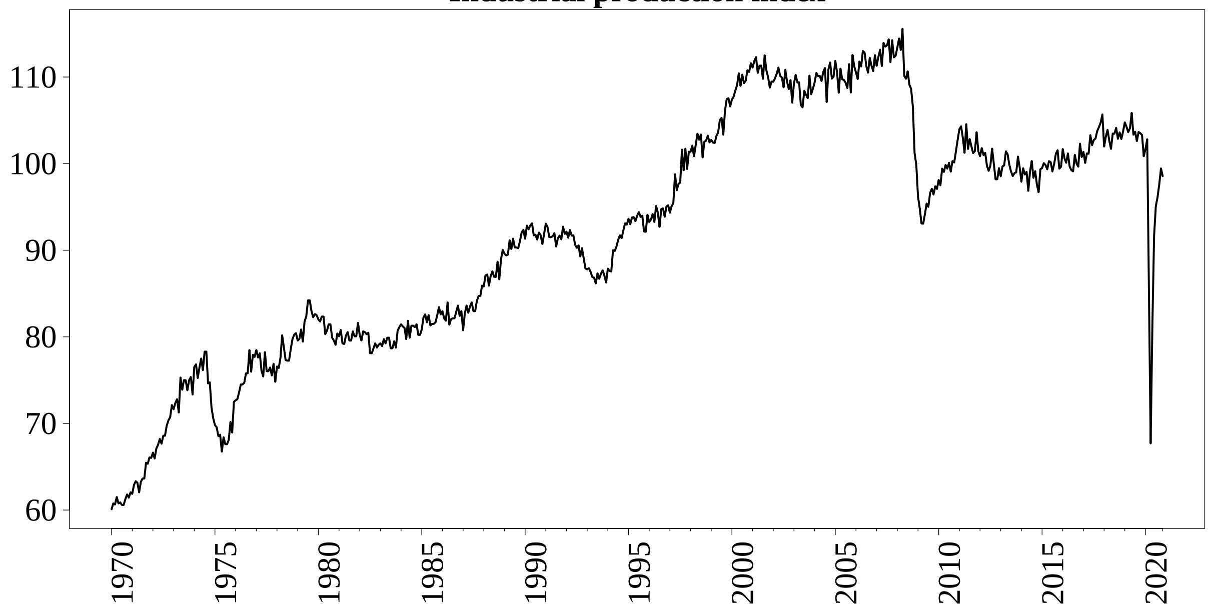

Figure A3 – **Opinion surveys published by the Insee**

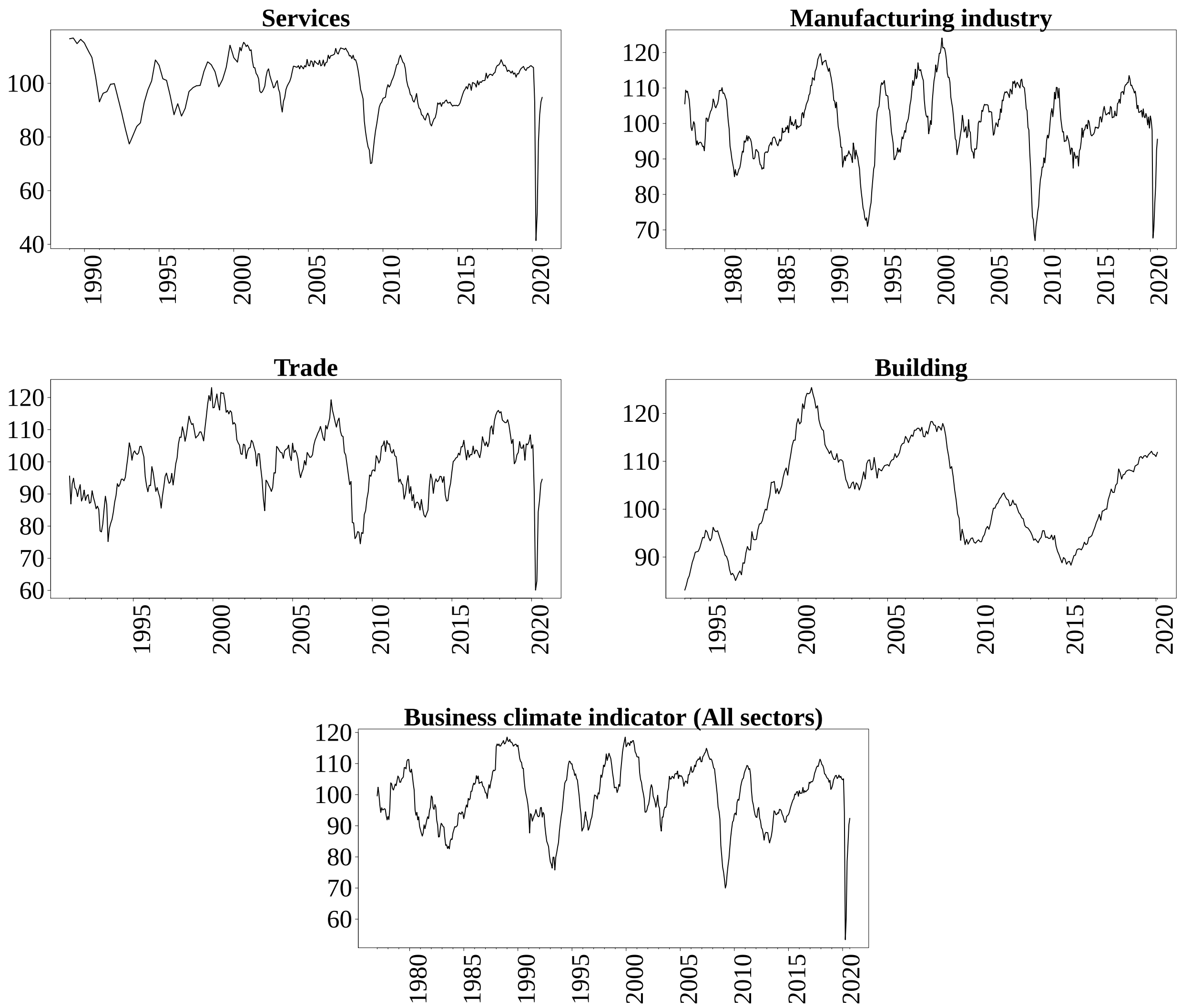

Figure A4 – **Smoothed probabilities of being in a recession regime stemming from estimated Markov-Switching models for each of the 5 considered variables**

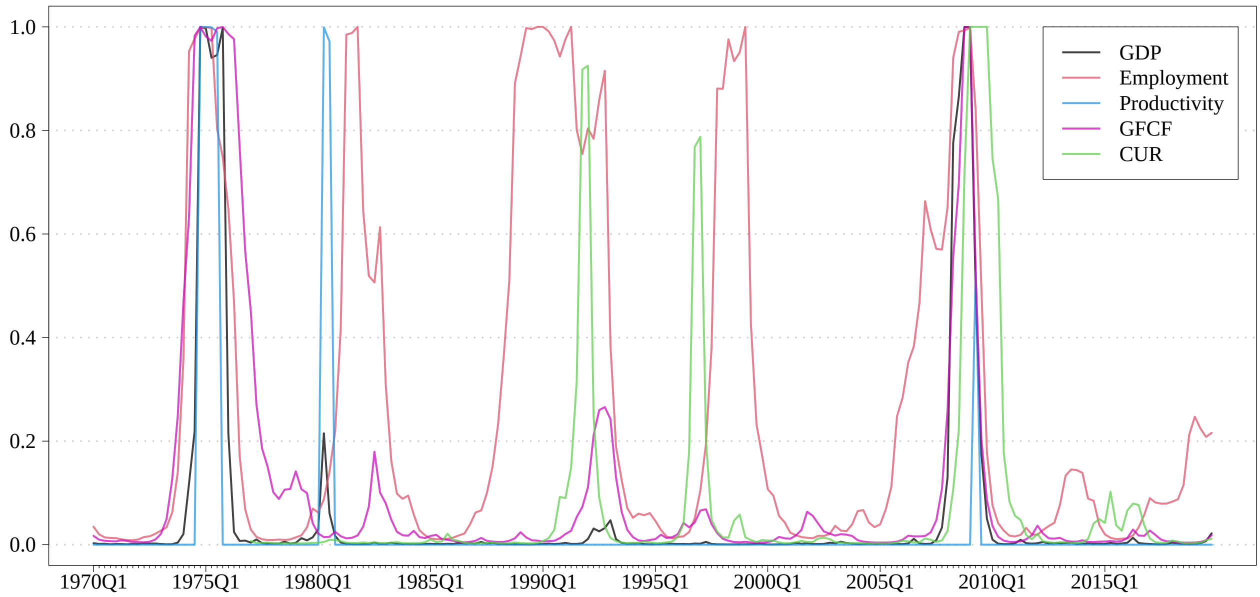

Table A1: **Evaluation of the diffusion of recession using opinion surveys**

	IP Manuf	*Services*	*Industry*	*Retail*	*Climate*	*Construction*
Peak	1974 M8					
Trough	1975 M5					
Peak						
Trough			1978 M2		1977 M12	
Peak	1979 M8		1979 M10		1979 M12	
Trough	1980 M10		1980 M12		1981 M3	
Peak	1981 M12		1982 M2		1982 M1	
Trough	1983 M10		1983 M7		1983 M9	
Peak					1986 M3	
Trough					1987 M3	
Peak			1989 M1		1989 M1	
Trough		1991 M1	1991 M2		1991 M2	
Peak	1990 M2	1992 M1	1992 M2		1992 M3	
Trough	1993 M11	1993 M1	1993 M6	1993 M6	1993 M6	
Peak		1994 M10	1995 M1	1994 M10	1994 M10	1995 M4
Trough		1996 M7	1995 M12	1996 M10	1995 M12	1996 M7
Peak			1998 M3	1998 M7	1998 M6	
Trough			1999 M3		1999 M3	
Peak	2001 M3	2000 M9	2000 M6		1999 M12	2000 M10
Trough	2001 M11					
Peak	2002 M8					
Trough	2003 M5	2003 M4	2003 M6	2003 M4	2003 M4	2003 M6
Peak			2004 M6			
Trough			2005 M4			
Peak	2008 M4	2007 M3	2007 M12	2007 M6	2007 M6	2007 M7
Trough	2009 M3	2009 M3	2009 M3	2009 M4	2009 M3	2009 M5
Peak	2011 M5	2011 M3	2011 M3	2010 M12	2011 M3	2011 M7
Trough	2012 M10	2013 M4	2012 M10	2013 M5	2013 M4	
Peak	2013 M11		2015 M9			
Trough	2014 M5		2016 M6			2015 M4
Peak		2017 M12		2017 M12	2017 M12	
Trough		2018 M12		2018 M12	2018 M12	
Peak	2019 M5	2019 M12	2018 M1	2019 M12	2019 M9	

Note: Services survey start in 1989, Industry survey in 1976, Retail survey in 1991, Climate survey in 1977, Construction survey in 1993, Minimum duration for a phase = 9 months.

Table A2: **Linearity tests**

	p	$\hat{m}$	$\hat{\ell}$	$\hat{\kappa}$	SupLR	p-value
GDP	2	1	2	-0.037	24.37	0.00
Employment	4	3	0	-0.048	17.68	0.02
Productivity	2	1	2	-0.116	25.06	0.00
Investment	2	4	1	-1.034	27.91	0.00
CUR	2	1	1	-1.048	23.65	0.01

Table A3: **Likelihood-Ratio tests: Specification of the bounce-back effect**

	H_1 : BBF	H_0^N : no BB	H_0^U : BBU	H_0^V : BBV	H_0^D : BBD	H_0^C : BBF$_c$
GDP	(-110.40)	**24.34**	**13.18**	**22.00**	**21.02**	3.66$^{(a)}$
Employment	(214.32)	**15.06**	**11.50**	**14.70**	0.62	—
Productivity	(-117.62)	**25.02**	6.30	**15.62**	**24.08**	—
Investment	(-321.50)	**30.08**	**26.88**	**30.08**	**26.04**	0.64$^{(a)}$
CUR	(-252.11)	**22.88**	**22.64**	**21.76**	5.5	—

Note: figures in parenthesis are log-likelihoods. Bold figures indicate the rejection of the null hypothesis at 5%. BBF$_c$ and exponent (a) correspond to constraints $\lambda_2 = \lambda_3 = 0$.

Table A4: **Parameter estimation of the threshold model**

	GDP	*Employment*	*Productivity*	*Investment*	*CUR*
	$\text{BBF}_c(2,1,2)$	$\text{BBD}(4,3,0)$	$\text{BBU}(2,1,2)$	$\text{BBF}_c(2,4,1)$	$\text{BBD}(2,1,1)$
γ_0	0.13	0.02	0.09	0.29	-0.01
	(0.06)	(0.01)	(0.06)	(0.13)	(0.10)
γ_1	-0.06	-0.06	0.06	-0.94	-0.33
	(0.12)	(0.02)	(0.10)	(0.37)	(0.31)
λ_1	1.14	*0.00*	*0.46*	1.60	*0.00*
	(0.25)		(0.10)	(0.29)	
λ_2	*0.00*	*0.00*	*0.46*	*0.00*	*0.00*
			(0.10)		
λ_3	*0.00*	-0.17	*0.00*	*0.00*	-0.62
		(0.04)			(0.15)
ϕ_1	0.39	1.18	0.30	0.40	0.19
	(0.07)	(0.07)	(0.08)	(0.08)	(0.09)
ϕ_2	0.34	-0.53	0.42	0.16	0.36
	(0.07)	(0.11)	(0.07)	(0.07)	()0.11)
ϕ_3		0.46			
		(0.11)			
ϕ_4		-0.26			
		(0.07)			
σ	0.43	0.06	0.45	1.22	1.17
n_0	181	169	177	172	142
n_1	19	31	23	28	21
$\overline{R}^2$	0.43	0.84	0.39	0.35	0.14
Q(4) p-val	0.26	0.30	0.97	0.55	0.87
ARCH(4) p-val	0.33	0.01	0.64	0.01	0.96

Note: BBF_c corresponds to the model BBF with constraints $\lambda_2 = \lambda_3 = 0$. Numbers in parenthesis are standard errors. Numbers in italics are constrained values. n_i is the number of observations in regime i.

Table A5: **Estimated parameters of the Markov-Switching models**

	GDP	*Employment*	*Productivity*	*Investment*	*CUR*	*GDP*	*Employment*	*Productivity*	*Investment*	*CUR*
	Recession (regime 1)					Expansion (regime 2)				
μ	0.05	0.03	0.42	-0.56	-0.71	0.50	0.02	0.74	0.48	0.02
	(0.51)	(0.01)	(0.01)	(0.63)	(1.19)	(0.11)	(0.03)	(0.13)	(0.12)	(0.07)
$D79T3$	-0.66					-0.27				
	(0.75)					(0.09)				
t			-0.01					-0.00		
			(0.00)					(0.00)		
ϕ_1	0.20	1.32	-0.56	0.47	0.40	0.28	1.21	0.21	0.44	0.10
	(0.39)	(0.09)	(0.00)	(0.21)	(0.31)	(0.07)	(0.15)	(0.07)	(0.07)	(0.09)
ϕ_2	-0.15	-0.59	0.33		-0.31	0.26	-0.54	0.22		0.23
	(0.46)	(0.14)	(0.00)		(0.38)	(0.07)	(0.23)	(0.07)		(0.08)
ϕ_3		0.24					0.48			
		(0.13)					(0.25)			
ϕ_4		-0.12					-0.35			
		(0.08)					(0.18)			
σ	1.03	0.05	0.01	2.32	3.04	0.34	0.14	0.40	1.08	0.80

Note: Numbers in parenthesis are standard errors.

Table A6: **Probabilities of transition in estimated MS models**

	GDP	*Employment*	*Productivity*	*Investment*	*CUR*
p_{11}	0.75	0.86	0.61	0.83	0.72
p_{12}	0.25	0.14	0.39	0.17	0.28
p_{21}	0.01	0.05	0.01	0.02	0.02
p_{22}	0.99	0.95	0.99	0.98	0.98

Note: Regime 1 (resp. 2) corresponds to the recession regime (resp. expansion regime).