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Leaders and followers in the business cycle game. A case study of the G7

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Abstract

The recent economic crisis has set the scene for new inquiries about the nature of this elusive phenomenon from both academics and practitioners. Understanding the driving forces behind of the world's economy starts with the comprehension of the components, and the classification thereof. The aim of this article is to divide the countries from the G7 group in leaders and followers in respect to the business cycle and specifically to the crisis. Markov switch models are employed in MATLAB through the MS_Regress to identify the turning points in a seasonally adjusted quarterly GDP series covering the time span 1991-2012. The stochastic model also gives the recession's probability of persistence together with the estimated duration. The results show a clear demarcation among the leaders and the followers, each country playing a different role during each phase of the business cycle. Furthermore, there is a significant quadratic link between the above mentioned probabilities and the duration of the crisis. The significance of this study resides in highlighting the business cycle anatomy for the most influential economic powers of the world, hence proposing a model which can be extended for another sample of countries in order to assess the transmission of the business cycle and especially the crisis, targeting the prevention or at least to attenuate the results thereof.

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1. Introduction

The late 2000's economic crisis has set the stage for asking once again important questions such as the significance of business cycles' synchronization, the influence of the relations among countries as regards to the transmission and the development of the crisis and each state's power to overcome the downfall based on its specific economic capacity and associations.

This paper sets out to understand the anatomy of the business cycle in each of the G7 countries, which form the most preeminent and influential group in the world economy. The final goal of such an endeavor is to understand the role each country assigns in the economic gear, thus leading to better hedging of the risks associated with the economic recession and crisis.

Until now, the G7 members were all considered economic leaders of the global economy, but a closer inspection inside the group could highlight the fact that among these countries some are leaders, while others are followers regarding the business cycle dynamics.

The aim of this article is to study the main characteristics of the business cycle phases such as occurrence, duration, and most of all change by employing a Markov chain switch model, the outcome of which will be to establish the status of each country after the 2000's crisis, as either a leader or a follower.

The rest of the paper is organized as follows: the next section presents the previous landmarks in academic literature, followed by data and model specification, the technique used to construct the business cycle turning points. Section 4 presents the results while Section 5 concludes and gives the limitations of the study.

2. Literature overview

The context offered by globalization relocates the business cycle issue, from a national background to an international and interconnected environment, as recent papers (Artis and Okubo, 2009; Kose, et al., 2013; Kose, et al., 2008) suggest.

There is an abundance of studies which are concerned with the transmission mechanisms like those of Eickmeier, (2007), and Fidrmuc, et al., (2012) and with the identification of turning points as marks of the business cycle phases, starting with the pioneering work of Hamilton (1989), which was continued and reinterpreted in the last two decades, as other papers (Bruno and Otranto, 2004; Chauvet and Hamilton, 2005) imply.

Although most papers focus either on the Euro area (Camacho, et al., 2006; De Haan, et al., 2008), or the US, there are some studies which target another sample, namely the OECD countries like that of Inklaar, et al. (2005), respectively the more exclusive but powerful group consisting of the G7 countries, disputed in the recent studies of (Canova, et al., 2007; Cologni and Manera, 2009; Chauvet and Yu, 2006; Stock and Watson, 2005). Due to the fact that in Europe one of the most preeminent economic powers is Germany, there are a number of studies concerned with the business cycle of this specific country, Fritsche and Kuzin (2005), or the link between Germany and the US (Eickmeier, 2007).

The topic of leaders and followers of the business cycle emerged as a natural concern in relation with the economic shocks (Cologni and Manera, 2009), which made their presence felt in the industrialized world, whether symmetric or asymmetric (Marley and Piger, 2010).

The problems posed by such studies revolve around the existence of a common business cycle (Artis and Okubo, 2009; Chauvet and Yu, 2006), understanding the determinants of such a macro-cycle and the national differences (Eickmeier, 2007).

The most important findings of previous studies are synthesized by Canova and Ortega (2007) and include the fact that national business cycles are diminishing in favor of a macro-cycle, at least in the Euro Area and that there is an increased synchronization pattern during recessions, which tends to diminish in expansions. The study of the G7 should pay special attention to Japan, which manifests a different economic behavior due to a less synchronized business cycle with the rest of the group and increased links with Asian countries, as Canova, et al. (2007) note.

Not all scholars are in favor of the macro-cycle theory; some papers (Kose, et al., 2008) propose the idea of a decoupling of some countries from the general core of the macro-business cycle, hence emerging the suggestion of leader countries as opposed to outliers.

Considering the methodological approaches in the literature, along with static models (Bruno and Otranto, 2004) and cluster analysis (Artis and Okubo, 2009; Camacho, et al., 2006), the Markov chains switch models came into sight as the most suitable to highlight the differences between business cycle phases (Fritsche and Kuzin, 2005; Krolzig, 2003) using historical data, organized into autoregressive vectors. The construction details of these techniques can be consulted in Hamilton (1989) from a theoretical point of view and in Perlin (2012) as regards suitable software.

3. Statistical approach

3.1. Population

The study focuses only on the members of the G7 group, namely the U.S., U.K., France, Germany, Italy, Canada and Japan. They are seven of the eight (China excluded) wealthiest nations of the world, judging by the global net wealth. The G7 represents more than the 66% of net global wealth (Credit Suisse Global Wealth Report September 2012).

In order to assess the business cycle fluctuations, a classical indicator was used, specifically the quarterly GDP growth rate, calculated by the expenditure approach, and seasonally adjusted, as retrieved from the OECD database (OECD, 2013). The time span investigated was 1991 Q1 until 2013 Q1, in order to include at least one complete business cycle as described by the Burns and Mitchell (1946) definition using turning points.

3.2. Method

The objectives of this enquiry are to determine the business cycle turning points in each G7 country, to estimate the probabilities of maintaining the current phase (expansion or recession), and to compute the average length of each phase. The most appropriate tools indicated by the literature for this kind of analysis are the Markov chains switch models. Regarded as a generalization of the linear regression model $y_t = \mu_t + \varepsilon_t$, the Markov switch model gives the freedom of choice between different states of the same process such as each state has different outcomes, as suggested by the equation: $y_t = \mu S_t + \varepsilon_t$, where S_t stands for the current state of the process at moment t and $\varepsilon_t \sim N(0, \sigma_t^2)$.

In this paper we shall consider a set of two possible states, namely expansion (State 1) and recession (State 2).

The main difference between a simple regression and a Markov switch model is that the transition of states is stochastic and not deterministic; hence one can compute only the transition probabilities, grouped in a transition matrix, where the row indicates the original state, while the column indicates the successive state:

$$P = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix}$$

Usually, during a determined time span, probabilities are assumed constant. A detailed description of the method can be consulted in the work of Hamilton (1989) and that of Kim and Nelson (1998), but for the current paper the brief description provided in Perlin (2012) will suffice.

The model considered is:

$$y_t = \mu S_t + \varepsilon_t, \varepsilon_t \sim N(0, \sigma_t^2), S_t \in \{1, 2\}$$

Estimating the transition probabilities of the model can be performed by introducing a likelihood function, more specifically a log-likelihood, and taking into consideration the fact that the states are not known explicitly, but only through their manifestations. According to Perlin (2012) the log-likelihood function based on previous conditions is:

$$\ln L = \sum_{t=1}^T \ln \sum_{j=1}^2 (f(y_t | S_t = j, \theta) P(S_t = j))$$

which is an weighted average of the likelihood function of each phase, by the phase’s probability of occurrence.

Computations of the probabilities are made in an iterative manner, as follows in the subsequent algorithm known as Hamilton’s filter, taking into consideration the information available at time t-1.

The MS_Regress MATLAB package (Perlin, 2012) uses the previous algorithm to compute the filtered probabilities, under the assumption that the probability law followed by the errors is Normal.

4. Results and discussions

The employment of Hamilton’s algorithm via the MS_Regress MATLAB package yields the results comprised in Tabel 1.

The first two rows state the probabilities for each country if it is a certain state (expansion/ crisis) to maintain its current behavior. A regime change is computed elementary by subtracting the given value from 1, hence obtaining the complementary probability: $p_{12}=1-p_{22}$; $p_{21}=1-p_{11}$.

While the probability for maintaining the expansion phase is common to all the countries (98%), hence proving similarities in their economic behavior, the probabilities concerning the crisis have a very different rage of values.

Tabel 1- Business cycle phases characteristics and occurrence probabilities

	Canada	France	Germany	Italy	UK	USA	Japan
<i>p₁₁</i>	0.98	0.98	0.98	0.98	0.98	0.98	0.98
<i>p₂₂</i>	0.65	0.71	0.50	0.66	0.74	0.77	0.92
<i>Expansion_med</i>	65.70	56.01	56.87	58.89	61.55	58.20	47.89
<i>Crisis_med</i>	2.88	3.46	2.01	2.91	3.85	4.36	12.12
<i>Crisis_in</i>	70.5	68.5	70.5	69	68.5	67.5	69
<i>Crisis_out</i>	Q ₃ 08	Q ₁ 08	Q ₃ 08	Q ₂ 08	Q ₁ 08	Q ₄ 07	Q ₂ 08
	73.5	72.5	72.5	72.5	73.5	73	83.5
	Q ₂ 09	Q ₂ 09	Q ₂ 09	Q ₂ 09	Q ₃ 09	Q ₃ 09	Q ₄ 11
<i>Crisis_duration</i>	3	4	2	3.5	5	5.5	14.5

These observations lead to the idea that there is a strong statistical link between the *p₂₂* probability of a certain country to remain in a crisis and the two subsequent variables, namely the expected duration of the crisis *Crisis_med* and the effective duration thereof (*Crisis_duration*).

Tabel 2- Regression parameters

Quadratic		Parameter estimates		
<i>R Square</i>	<i>Sig.</i>	<i>Constant</i>	<i>b1</i>	<i>b2</i>
,983	.000	29,023	-95,016	83,009

Running a Curve estimation algorithm in SPSS 20 with *p₂₂* as the independent variable and *Crisis_med* as dependent, it comes that there is a strong quadratic link, as depicted by

Tabel 2. The Value of R square and that of the significance (Sig.) implies that the quadratic model is statistically significant and that is appropriate.

The behaviour of each country is presented in Figure 1.

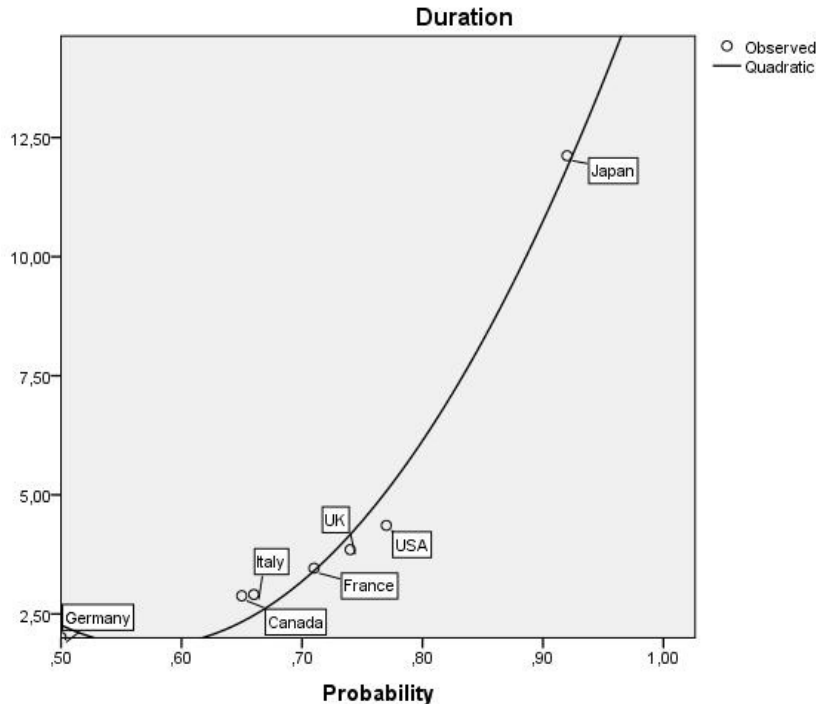


Figure 1- Quadratic dependence between probability and duration for crisis

A similar result is obtained if the model is employed using p_{22} as the independent variable and *Crisis_duration* as the dependent variable due to the fact that the difference between the predicted duration of the crisis and the actual recorded value is very small, hence proving the validity of the model.

Turning to the aim of the paper, if we were to study the order of submerging into the crisis/ overcoming the crisis, the following sets emerge:

- 1) USA < UK < France < Japan < Italy < Canada < Germany
- 2) Germany < France < Italy < USA < Canada < UK < Japan, as graphically depicted in Annex 1.

The result states a strong correlation of the business cycles between the G7 countries. Yet, this result is hidden due to the fact that the correlation spreads along a wider time span and it is influenced by a certain lag. Also, the relationship between countries is in close connection with trade (Chauvet and Yu, 2006), (as a symmetrical factor) but also asymmetric influences such as oil shocks (Cognigni and Manera, 2009; Marley & Piger, 2010).

The sample of countries can be divided into two groups, namely leaders and followers, both as regards entering the crisis phase and overcoming it.

As concerns the submergence into the crisis, USA is the ultimate leader, because it was a victim of the “too big to fail” idea, closely followed by the UK, due to close trading relationship.

Notably, Canada did not follow the same pattern, although it was geographically and economically closer to the US due to the fact that it implements a very different banking system, as Bordo et al. (2011) notice.

Germany, on the other hand is at the opposite end of the transmission cycle, although it experiences symmetrical business cycle movements with the US, as Eickmeier (2007) proves, these fluctuations are delayed, and furthermore they are less severe because are transmitted exclusively through trade channels, so it is more likely for such influences to have greater impact as regards positive movements. The financial and portfolio channels have a diminished role between Germany and the US, hence providing a limitation of the possible negative outcomes.

Japan’s case is by far the most intriguing because, although at first it seemed like the crisis would bypass the Nippon economy, the harsh reality struck with a delay of 2 quarters but with devastating effects. This was a direct

result of Japan's economic structure: "over 90% of Japanese exports consist of highly income elastic industrial supplies, capital goods, and consumer durables. Hence a collapse of the US and European markets exerted a severe negative influence on Japanese exports." (Kawai and Takagi, 2009).

Also, the country was affected by an otherwise positive economic feature, namely trade openness, which can be considered a natural part of globalization and regional integration. However, the way in which this process was implemented in the specific case of Japan, made it particularly vulnerable to a large output shock coming from outside (Kawai and Takagi, 2009).

Apart from Germany, the other two mainland European powers, France and Italy have been affected by the late 2000's crisis due to high business cycle synchronization with the other European countries (De Haan, et al., 2008) and also being hosts of housing bubbles similar to the ones in the USA (Putland, 2009).

Yet, France had a very mild recession compared to the other countries in the G7 group and as a result it recovered very quickly, being the second after Germany, although this was the economical outcome of very unpopular austerity programs, reducing their budget deficits relative to GDP measures which caused fierce protests, while Italy benefited from tax rebates reform of the taxation system to support specific sectors such as housing.

5. Conclusions

The G7 group can be divided in leaders and followers according to their behavior during the late 2000's economic crisis. Hence, while entering the crisis, US, UK and France may be considered leaders and Japan, Italy, Canada and Germany followers, when it comes to crisis overcoming, the roles almost switch: the three European mainland powers (Germany, France and Italy) are the leaders, while US, Canada, UK and Japan hesitatingly follow.

Such a result is important in the wider context of globalization and within the framework provided by business cycle synchronization. Knowing such a hierarchy together with the motivation thereof could prove vital in the potential episode of another crisis.

This result was statistically proven by means of Markov switch models, which set out to determine the occurrence of the crisis and the duration of each business cycle phase for every country.

The findings showed that there is a statistically significant quadratic link between the probability of a certain country to remain in a recession (or even crisis) once this phase has been installed and the duration of the recession phase.

Apart from the US which have triggered the 2007 crisis, Germany has the most preeminent role of the analysis attributable to the fact that it has the lowest probability of remaining in the crisis, hence the lowest duration of the recession, positively influencing in this respect the other European powers, both through economic channels such as trade and through European policy propositions.

On the other hand, Japan suffered from its own previous success determined by the very structure of the economy and from strong trade links with other developed countries. Its rehabilitation after the crisis took four times as long as the average for the other countries due to the fact that it needed to wait for its economic partners to regain their financial power.

The contributions of this study are two folded: economically it offers a classification of the world's most important economies in leaders and followers of each other, as a base for the unfolding of the recent economic crisis outcomes, and methodologically proves once again the predictive power of the Markov switch models.

The limitations of the study are related to the size of the sample and the time span under analysis. These problems could be easily overcome by enlarging both the dataset and/ or the period.

Further work will focus on the classification as leaders and followers of a larger sample of countries highlighting the economical context which facilitates such a classification. This is an important feature since national or regional variables primarily affect domestic outcomes, which spread to international and world level, thus policies designed to counteract the tendencies dictated by world conditions may be ineffective.

The overall importance of this study is that it dictates the direction of counteracting negative events: from source to manifestation.

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