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Global Business Cycles: Degree of Synchronization in the Current Downturn is Unprecedented

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Empirical data analysis shows that the business cycles of industrialized nations demonstrate a fairly strong degree of synchronization in periods of growth, and a lesser degree of synchronization during periods of contraction. The current recession, however, breaks this pattern: the business cycles of industrialized nations have exhibited an unprecedented degree of synchronization since the start of the crisis. In the worst economic downturn since the end of the Second World War, the most important national economies have been drawn one after another into the maelstrom of global recession.

In this paper we present a method for measuring business-cycle synchronization between individual countries. In our comparison of the current crisis with previous recessions, a focus is placed on the G7 nations and Germany's most important trading partners.

The collapse of the financial and real-estate bubbles in the US rapidly triggered a global drop in production comparable to the economic crisis of 1929. While there were many indications in 2008 that a recession was in the cards for Germany, nearly all observers underestimated its future severity. One key reason for this was the assumption that economic turmoil in the US would not spread into a global conflagration. Many economists thought that much of the emerging world would not be affected by America's homegrown problems—it was often claimed, for example, that emerging economies were undergoing a robust and independent form of development. As a consequence, economists also assumed that a continued demand for imports in such developing nations would help to bolster the economies of industrialized nations and mitigate the effects of reduced demand from the US.[1]

The forecasts released by international organizations illustrate the stark discrepancy between expected and actual GDP growth rates: in the fall of 2008, for example, the IMF forecasted a real GDP growth rate for 2009 of 0.5% for industrialized countries, 3.4% for Eastern and Central Europe, and 5.5% for Russia. Just six months later, in April of 2009, the expected growth discrepancy between industrialized countries and emerging economies had drastically changed: the 2009 GDP growth

1 See Dreger, C. et al.: Herbstgrundlinien: Realwirtschaftliche Auswirkungen der Finanzkrise beherrschbar, DIW Berlin Wochenbericht 41/2008.

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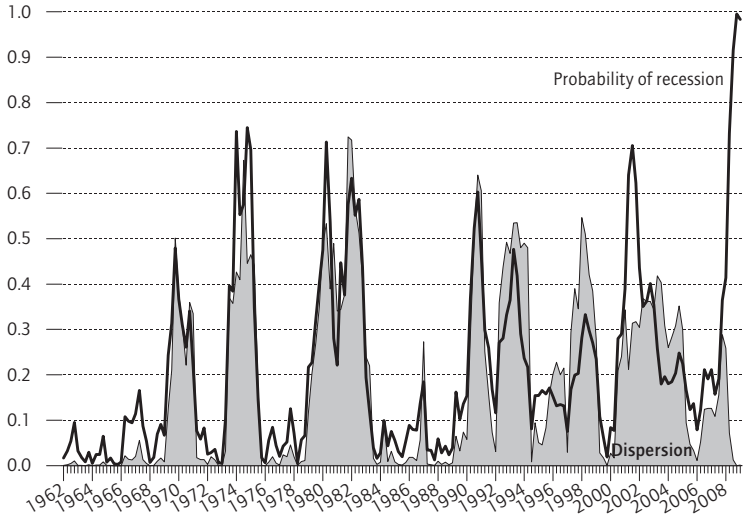
forecast was revised to -3.8% for industrialized nations, -3.7% for Central and Eastern Europe, and -6.0% for Russia. In July of 2009 these figures were revised once again: while the forecast for industrialized countries remained unchanged at -3.8%, a growth rate of -5.0% was forecast for Eastern and Central Europe, and -6.5% for Russia. Thus, although the consensus view in the fall of 2008 was that most emerging countries on the European continent would barely be affected by the financial crisis, in the meantime growth estimates for these countries have been totally revised.

The erroneous expectations that financial market turmoil would only have a limited impact on international economic growth can be partially attributed to the influence of business-cycle research. Studies analyzing the increasing integration of trade and financial markets with a view to business cycles in industrialized and developing countries have suggested that globalization does not lead to significantly greater business-cycle synchronization.[2] In another empirical study of interdependencies in international business cycles between 1960 and 2005 the results show that business cycles in industrialized nations have been convergent over the last twenty years (1985-2005). The same applies to developing nations. However, the divergence between industrialized and developing nations has tended to grown larger.[3] Because of studies like this, the rapid global spread of the crisis was not expected.

Figure 1

Average Recession Probabilities in the G7 Nations

"Expansion"= 0 to "Contraction" = 1



Sources: Global Insight; calculations by DIW Berlin. **DIW** Berlin 2009

A Method for Measuring Business-Cycle Synchronization Between Individual Economies

The depth of the crisis is easy to determine based on the typical indicator used in economic forecasts: the rate of change in real GDP. By contrast, it is much more difficult to determine the degree of business-cycle synchronization between individual countries and within economic blocs. In the following, we present a method to do just this.

Our method is based on Markov switching models, which, with the aid of time series, allow one to calculate the probability that an economy was in a phase of expansion or contraction at a specific point in time (see Box). We conduct two analyzes in the present paper. The first evaluates the degree of business-cycle synchronization in the most important industrialized nations (the G7, consisting of the US, Germany, Japan, Britain, France, Canada, and Italy). The second analysis looks specifically at Germany's ten most important trading partners. Quarterly changes in real GDP serve as data. Unfortunately, an analysis of other countries is not possible due to insufficient data.

In order to measure the synchronization of business-cycle fluctuations, the probability that each country is in a recession is first calculated for each quarter. This probability can have a value between 0 (expansion) and 1 (contraction). Next, the mean probability of recession for all countries is determined for each quarter. If the mean is near 0 or 1, this means that the majority of countries are in an expansionary or recessionary phase. As the countries included in the analysis differ considerably from each other in terms of their economic strength, the calculated mean probability of recession is weighted based on each respective GDP figure (in US dollars at 2005 prices). In addition, the degree of statistical dispersion (calculated as the sample variance multiplied by four) is computed for the recession probabilities.

2 Kose, M.A., E.S. Prasad, M.E. Terrones: How Does Globalization Affect the Synchronization of Business Cycles? American Economic Review 93(2), 57–62.

3 Kose, M.A., C. Otrok, E.S. Prasad: Global Business Cycles: Convergence or Decoupling? NBER Working Paper No. 14292.

Markov Switching Models

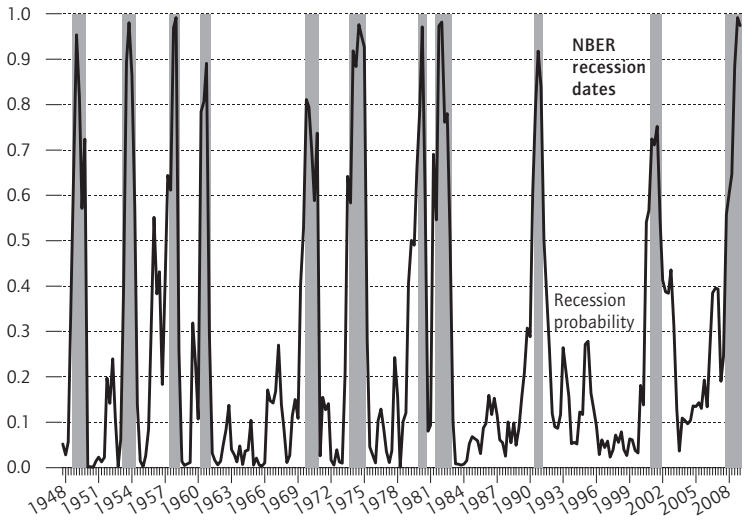
How can one determine the probability of recession for any country at any given point in time? We employ the so-called Markov switching models, which have particularly proven their usefulness in empirical business cycle research over the last two decades. The use of this class of model in empirical business-cycle research goes back to J. Hamilton, who applied it to estimate the dynamics of real GDP growth rates in the US for the period from Q2 1952 to Q4 1984.[1] The recession probabilities predicted by the model correspond to large extent with the official business-cycle dates maintained by the National Bureau of Economic Research (NBER). Krolzig has provided for the comprehensive technical generalization and systematization of this model class, particularly with regard to empirical business-cycle research [2].

In a Markov switching model, it is assumed that the process generating the observed data—in our case, growth in real GDP—is dependant on a qualitatively unobservable variable. In its behavior, this variable is subject to certain systematic rules—in the literature known as "Markov chains." The concrete values that this variable takes on are described as "states." In the investigation of business-cycle fluctuations, the Markov chain has two states: "expansion" and "contraction." The state of "expansion" is generally associated with positive real GDP growth, and "contraction" with negative growth. In a statistical estimation procedure, the goal is to link assumptions about these states with the actually existing dynamic structure in the real GDP time series and to provide an estimation of probabilities for the states of "expansion" or "contraction" at each point in time. An example for an empirical application of the model is peformed based on real GDP growth in the US: We take growth rates from Q1 of 1947 to Q1 of 2009 and calculate a Markov switching model with two states based on this data. For the purpose of illustration the estimated recession probabilities are displayed for the US at left. The recession probabilities clearly correspond with the official NBER dates for recessionary periods.

Figure

Recession Probabilities in the US

"Expansion"= 0 to "Contraction" = 1



Sources: Global Insight; calculations by DIW Berlin. **DIW** Berlin 2009

Drawing on Krolzig's terminology, we employ the so-called MSI(K)-AR(p) models—the abbreviation stands for Markov Switching in Mean Autoregressive—in order to describe the real GDP growth rate. K stands for the number of different states and p for the number of autoregressive lags that go into the formula. For all countries, only two states are possible—"expansion" or "contraction." However, the number of autoregressive lags is determined by the dynamic characteristics of each times-series. Formally, the MSI(2)-AR(p) formula is expressed as

$$x_t = \alpha(s_t) + \varphi_1 x_{t-1} + \ldots + \varphi_p x_{t-p} + u_t$$

where $\varphi_i x_{t-i}$ represents the lags with the corresponding parameters—the autoregressive element (AR)—and u_t unsystematic white noise. s_t stands for the unobserved Markov chain and takes the values of "expansion" or "contraction." In the "expansion" state, the parameter $\alpha(\cdot)$ has a positive value. This value is negative, by contrast, in the "contraction" state. In this way, $\alpha(\cdot)$ is the only state-dependent parameter, and is decisive for the characterization of the business cycle. If one ignores the fact that $\alpha(\cdot)$ is dependent on a unobserved discrete process, then the formula corresponds with the calculation of a linear au-

1 Hamilton, J.D.: A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. Econometrica 57, 1989, 357-384.

2 Krolzig, H.-M.: Markov-Switching Vector Autoregressions. Modelling, Statistical Inference and Application to Business Cycle Analysis. Lecture Notes in Economics and Mathematical Systems, Volume 454, Berlin 1997.

toregressive process of the order p. This fact is exploited in the data-driven selection of the lag order p, which is is first determined based on a linear autoregressive process with the Schwarz Information Criteria (SIC) and then used in the estimation of the Markov switching model.

If one has estimated the model by the maximum likelihood method, it is necessary in the next step to obtain information about the (unobserved) states of s_t. Two algorithms which represent the actual core of the method are used for this purpose: A filter algorithm, and a smoothing algorithm. With the filter algorithm it is possible to calculate the probability of a specific state based on the estimated model and depending on the data provided up to a given point in time t—for example, the probability of "contraction."

$$P(s_t = \text{"Contraction"} \mid x_1, x_2, ..., x_t)$$

By contrast, the smoothing algorithm determines the probability of a given state based on all available data (up to the last point in time T), thus providing more precise inference

$$P(s_t = \text{"Contraction"} \mid x_1, x_2, ..., x_T)$$

If one views the last available data point T, the results of the filter and smoothing algorithms correspond.

Probabilities calculated using the smoothing algorithm are often described as "smoothed" probabilities. They represent time series that correspond with the dimension of the original GDP time-series data. These time series can then be interpreted in several ways—for example, by comparing them with official dates concerning recessionary periods.

Expansionary Phases Convergent, Recessionary Phases Divergent

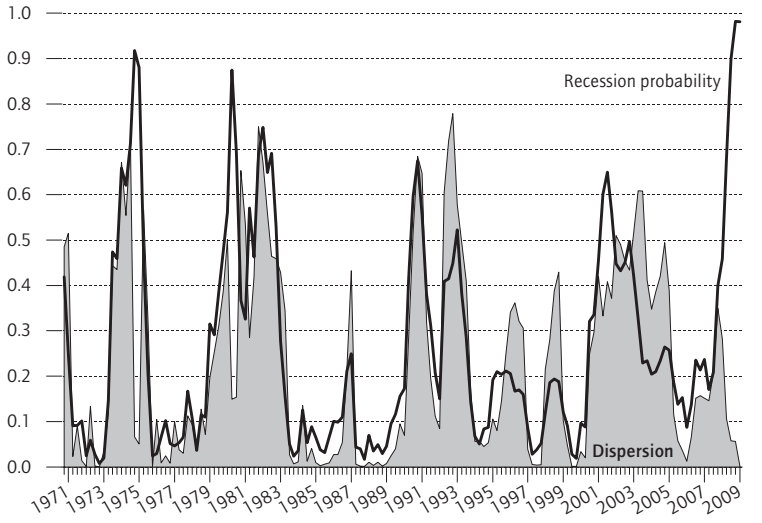
In the current crisis, the weighted mean probability of recession for the G7 is nearly 1. Since Q1 of 1956 (we use quarterly data starting from this point in time) this value has never been as high in any other recession (see Figure 1). The highest previous values during the first (1973) and second (1979) oil crises and the recessions that followed are under 0.8. A much higher degree of dispersion between the business cycles of the G7 is also apparent in comparison to the current recession. Based on this it can be concluded that the oil crises had a much more varied impact from country to country than the current recession. A similar picture is revealed when one examines Germany's most important trading partners (the US, Britain, Belgium, France, Italy, Netherlands, Spain, Switzerland, and Austria).[4] The degree of business-cycle synchronization during the oil crises was stronger among these countries than the G7 nations, however (see Figure 2).

In past expansionary periods things looked a bit different, however. The countries within both groups (i.e. the G7 nations and Germany's trading partners) underwent expansionary phases largely in parallel, with very little divergence between business cycles, as demonstrated by the very low dispersion. Business-cycle synchronization between Germany's trading partners was even higher than it was among the G7 nations. This is likely attributable to the very close integration of Western Europe's national economies.

Figure 2

Average Recession Probabilities Among Germany's Most Important Trading Partners

"Expansion" = 0 to "Contraction" = 1



Sources: Global Insight; calculations by DIW Berlin. **DIW** Berlin 2009

4 Poland is not included in the analysis as the available time series is too short to ensure a meaningful statistical assessment of the model parameters.

Conclusion

The method of analysis presented in this article enables one to quantify the degree of synchronization between business cycles. The analysis shows that the current crisis has spread among industrialized nations with a degree of speed and synchronicity not witnessed since the end of the Second World War. In the past, a general recessionary phase tended to affect individual countries with a greater degree of variation.

The question as to why the past was different must remain unanswered for now. It is likely that increasing economic integration has elevated the "risk of infection" between countries in times of crisis. This interpretation is supported by the historically high degree of business-cycle synchronization witnessed in the wake of the dot-com crash. Another factor likely contributing to the high degree of synchronization today is the tremendous disruptive strength of the US financial crisis, which rapidly forced production cutbacks in all industrialized and emerging nations. This crisis also exposed overinvestment in certain markets outside of the US—particularly in real estate.

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