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Sunspots, GDP and the stock market

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Abstract

A correlation has been observed between the US GDP and the number of sunspots as well as between the Dow Jones Industrial Average and the number of sunspots. The data cover 80 years of history. The observed correlations permit forecasts for the GDP and for the stock market in America with a future horizon of 10 years. Both being above their long-term trend they are forecasted to go over a peak around Jun-2008.

Keywords: Sunspots; Stock market forecast; GDP forecast

1. Introduction

There have been many claims and counterclaims for the existence of a correlation between sunspot activity (as measured by the number of sunspots) and the economy or stock-market movements. Interestingly, opponents of this notion, like astronomers J. V. Wall and C. R. Jenkins, claim that this correlation is well-known but mainly as folklore because trying to substantiate it is very difficult — and trying to find an underlying physical cause even more so. But they admit that this correlation may after all exist because global temperature is now known to correlate with sunspot number and long-term weather trends may have physical, social and economic effects [1].

At the same time, proponents of this notion, like "guru" Michael Wells Mandeville, claim, "it is easy to see that both political and economic affairs are profoundly caught up and influenced by the 'waves' of sunspot energy." But he also admits that there is zero correlation between daily price movements and average daily sunspot numbers and there is only a weak connection between long-term historical trends in the prices and average monthly or annual trends in the numbers of the sunspots [2].

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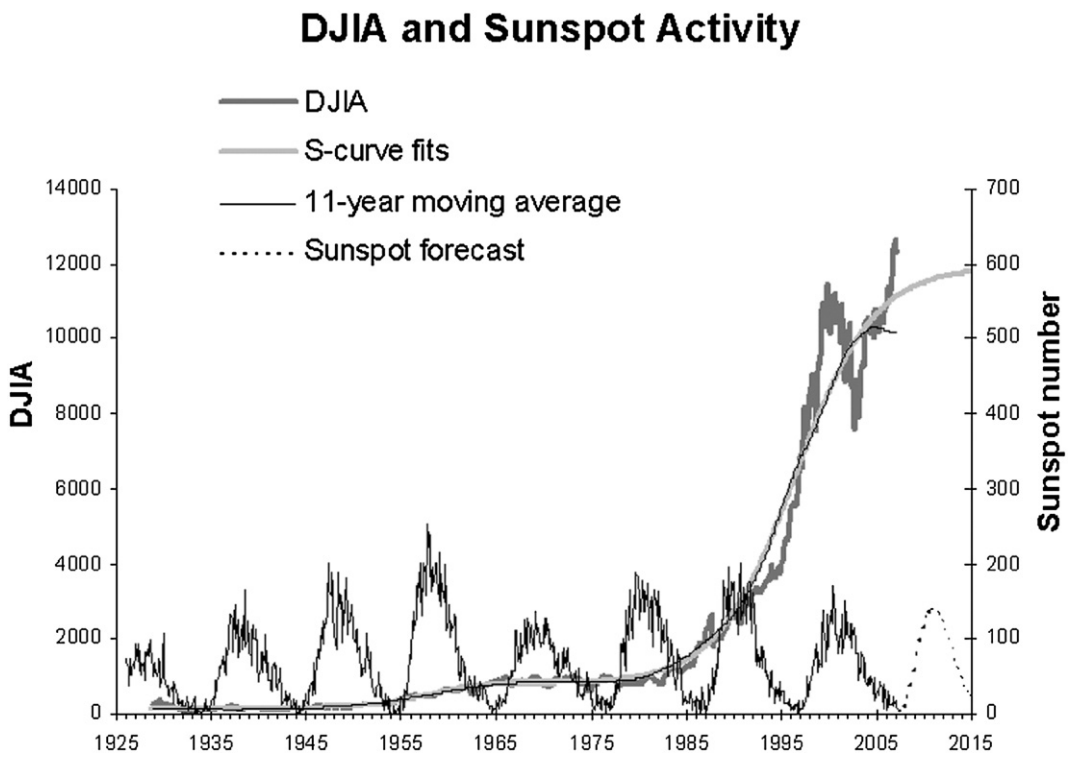

Fig. 1. Raw monthly data for the DJIA and the sunspot number. The dotted line is a forecast provided by NASA. The thin solid line is an 11-year moving average. The gray line shows two logistic fits, see text.

The work reported here presents hard-to-dispute evidence for the existence of a correlation between stock-market movements as measured by the DJIA (Dow Jones Industrial Average) and sunspot activity, as well as between GDP growth and sunspot activity. No causality arguments are made and there is no attempt to understand the mechanisms behind the observed correlation. The author would be satisfied with as little explanation as the possibility that sunspot activity may influence the climate on earth, which in turn may influence the economy.

Still, given the correlation and the rather reliable forecasts for sunspot activity provided by NASA, the author ventures long-range forecasts for GDP growth and the stock market in the United States.

2. Sunspots and the DJIA

Extensive detailed monthly data are available for both the DJIA [3] and for the number of sunspots [4]. Moreover, NASA provides a rather reliable forecast for the next 11 years of the latter [5]. The raw data are shown in Fig. 1. The lower time limit 1-Oct-1928 is the earliest monthly reporting of the DJIA [3]. The most recent data point is at the end of Mar-2007.

It is very difficult to search for evidence of correlation between the DJIA and sunspots in Fig. 1. The endeavor becomes more realistic if one looks at deviations from the long-range trends. Long-range trends are traditionally extracted via moving averages. It this case it was reasonably expected (and subsequently

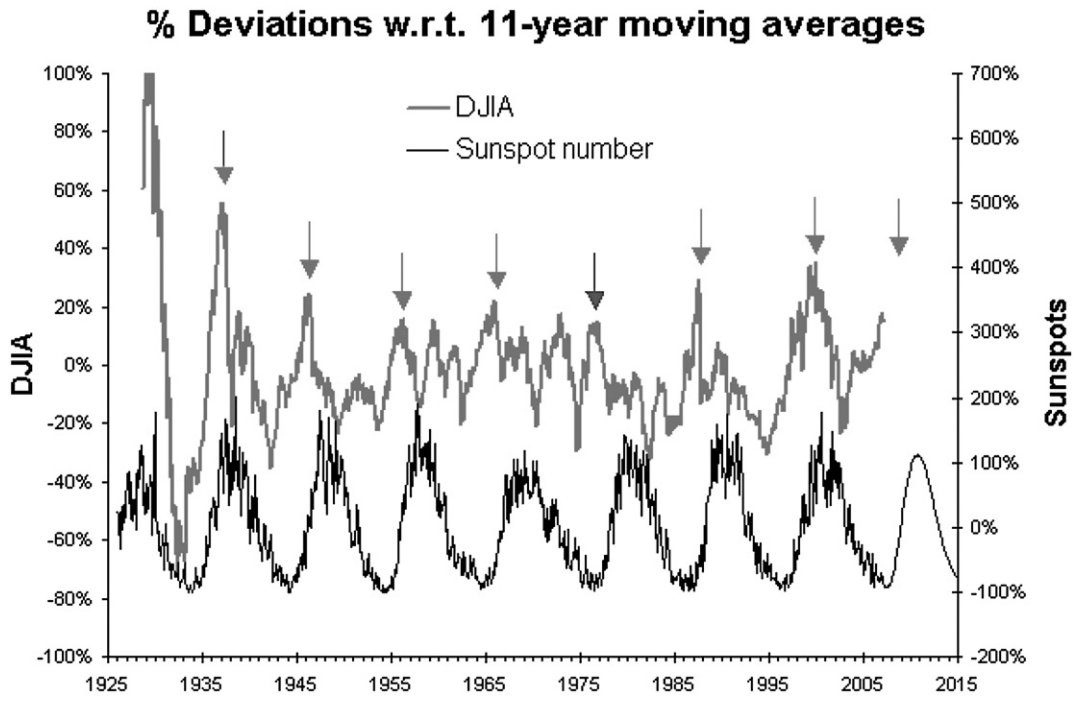

Fig. 2. Percent deviations with respect to the long-term trends as calculated via 11-year moving averages. The arrows point at the "significant" DJIA peaks. The last arrow is a forecast (Jun-2008), see text.

observed) that an 11-year average wash out the ups and downs of the sunspot activity. On the DJIA data, the 11-year average outlined two well-defined S-shaped steps punctuated by the mid 1970s.

Logistic fits were fitted on the two S-shaped steps of the DJIA trend, one for the range Mar-1934 to Dec-1979 and another one for the range Jan-1973 to Sep-2001, also shown in Fig. 1. The edge limits of Mar-1934 and Sep-2001 were dictated by the 11-year average, which becomes uncertain toward the edges of the range. The decision to fit logistic curves on these two segments of the overall range was arbitrary

Table 1
All dates are in decimal fractions of a year

DJIA peaks	Sunspot peaks	Delta
1937.17	1938.25	1.08
1946.33	1948.67	2.34
1956.25	1958.42	2.17
1966.00	1969.25	3.25
1976.50	1980.83	4.33
1987.58	1990.50	2.92
1999.92	2001.17	1.25
		Ave. delta=2.48
Forecast:		
2008.44	2010.92	

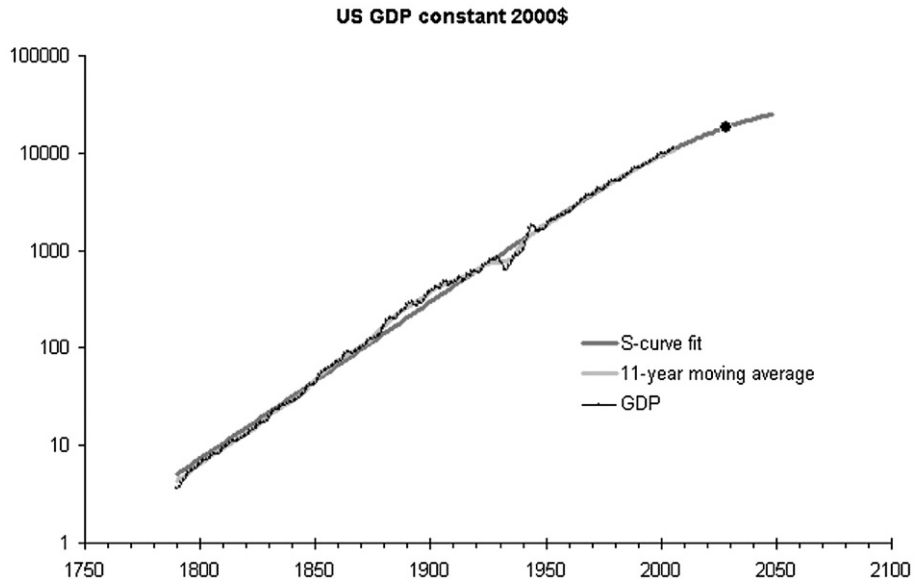

Fig. 3. Yearly data for the long-term evolution of the US GDP in constant dollars of 2000. The light-gray line is a trend established by an 11-year moving average. The dark gray line is a logistic fit to the 11-year trend line.

because there is no reason to believe that the growth of DJIA follows a logistic. The decision is justified to some extent *a posteriori* by the goodness of the fits: the correlation coefficients were 0.9976 for the former and 0.9996 for the latter. The slope of the trend has been slowing down for some time and presently is at 1.2% per year.

Fig. 2 shows the percent deviations from the moving-average trends both for the DJIA and the number of sunspots. To minimize uncertainty the deviations are taken with respect to the fitted trends at the edges of the data range.

The fluctuations of the DJIA pattern are more irregular than those of the sunspots. The mathematically calculated correlation between the two patterns is not significant. But there is enough visual similarity between the two patterns to raise suspicion. Small arrows point out the tallest well-defined peaks of the DJIA pattern. They seem to regularly precede the peaks of the sunspot pattern. Table 1 gives the time difference between each arrow and the central time of following sunspot peak. The last arrow is positioned at the average distance ahead of the forecasted sunspot peaks.

3. Sunspots and the GDP

The possibility that DJIA fluctuations may be synchronized with sunspot fluctuations prompted a search for a similar relationship between GDP and sunspots. Monthly data were not available for the GDP so Fig. 3 shows the yearly evolution of US GDP in constant dollars of 2000 up to the end of 2006 [6]. Once again the trend has been extracted via an 11-year moving overage, which gave a very good fit to a logistic, correlation coefficient 0.9996. Today the trend slope is 2.6% per year. The midpoint of this logistic is anticipated for mid-2028, at which time the US GDP will grow on the average at a maximum annual rate of 345 billion dollars of 2000.

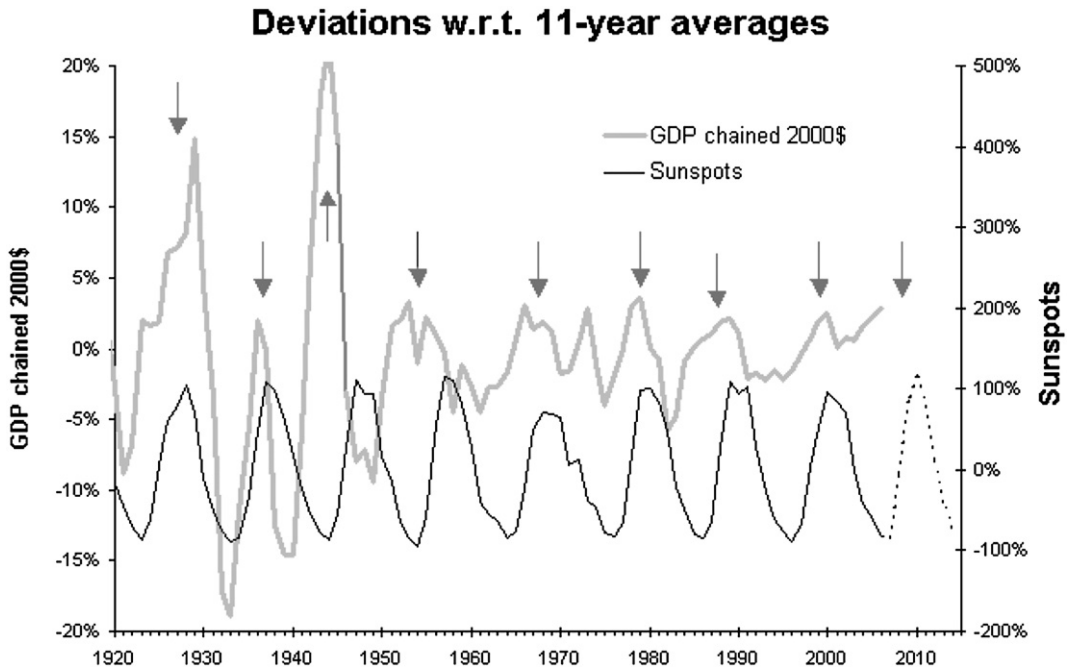

Fig. 4. Percent deviations with respect to the long-term trends as calculated via 11-year moving averages. The arrows point at the "significant" GDP peaks. The last arrow is a forecast (Jun-2008), see text.

As with the DJIA the data must be de-trended before any correlation can show up. Percent deviations with respect to the 11-year moving average are calculated for both GDP and sunspots. Once again, the fluctuations for the edge points are calculated with respect to the fitted S-curve of Fig. 3 so as to avoid any uncertainties stemming from incomplete averages. For the sake of direct comparison Fig. 4 extends over the same chronological period as Fig. 2.

The correlation between GDP and sunspot fluctuations is again not demonstrable mathematically but visually it is more striking than that between DJIA and sunspots. Here again the GDP peaks precede the sunspot peaks in a rather orderly manner; only one significant fluctuation around 1973 is not synchronized with the sunspot "clock" (it may be accidental but it is interesting to note that the irregularities of both DJIA and GDP patterns around this time are associated with the most irregular sunspot cycle).

The arrows in Fig. 4 point at the center of the upward excursions of the GDP pattern. The last arrow is positioned at the expected average distance ahead of the forecasted sunspot peak, see Table 2.

4. DJIA and GDP

The fact that both the DJIA and the GDP seem to be correlated with the sunspots suggests that there should also be some correlation between DJIA and GDP. Such correlation would be much easier to justify because both these variables reflect the state of the economy in some way. Superimposing the DJIA and GDP curves from Figs. 2 and 4, and plotting only yearly points, we obtain Fig. 5.

Table 2
All dates are in decimal fractions of a year

DGP peaks	Sunspot peaks	Delta
1927.92	1928.92	1
1936.50	1938.92	2.42
1944.92	1948.33	3.38
1954.92	1958.92	4
1967.20	1969.92	2.72
1978.70	1980.92	2.22
1987.50	1990.10	2.6
1999.92	2001.92	2
		Ave. delta=2.54
Forecast:		
2008.38	2010.92	

Indeed the two patterns seem to overlap more than just accidentally. Nevertheless, once again the correlation coefficient mathematically calculated indicates no significant correlation ($r=0.5$).

5. Forecasts

The correlations observed can be combined with the trends to produce long-range forecasts for the DJIA and the GDP. The present upward excursions of the DJIA and GDP should continue until Jun-2008. Considering the regularity of past upward excursions we can assume that the recent upward slopes will persist until the time of the climactic point indicated by the right-most arrow on Figs. 2 and 4. At that time — around Jun-2008 — the excursions will have reached 12.6% and 1.1% with respect to present levels for the DJIA and GDP respectively. But these excursions take place on top of the trends, established

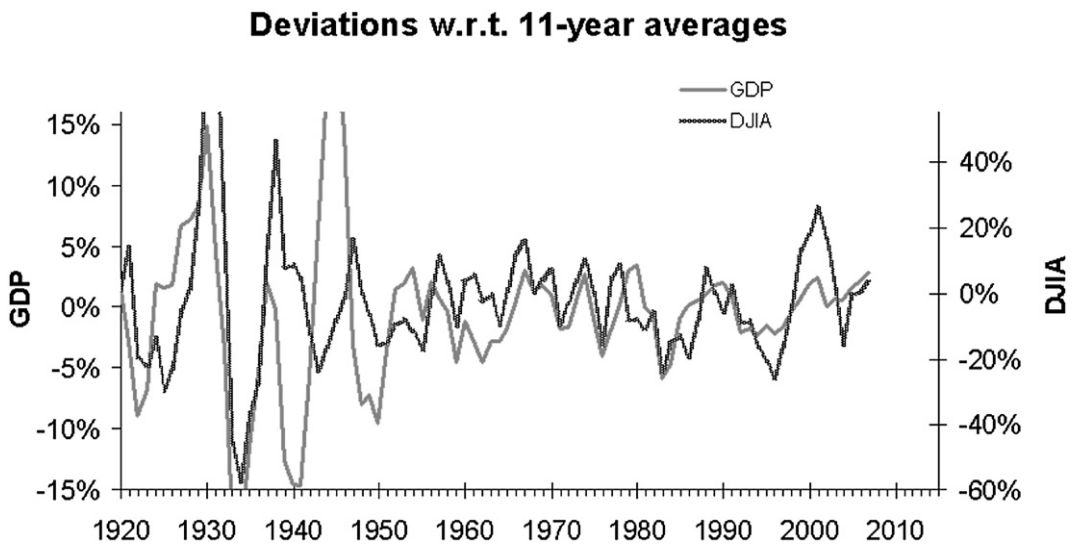

Fig. 5. We see superimposed here the DJIA curve from Fig. 2 and the GDP curve from Fig. 4.

as 1.2% and 2.6% respectively. Therefore, the level forecasted for the DJIA in Jun-2008 is 13908, and that for the GDP is 11976.5 billion dollars of 2000.

From mid-2008 onward both the stock market and the GDP should move downward toward their long-range trends. Invoking again the regularity of past fluctuations it is assumed that the downward movements will follow slopes equal to the negative of the upward ones and for the same duration. The calculations yield a rock-bottom level of 7919 for the DJIA in early 2014, and 12900 billion 2000$ for the GDP in late 2012.

6. Conclusions

Science-based decision-making tools enjoy objectivity and are particularly useful in situations where human bias can play an important role. But defending the idea that stock-market growth correlates to GDP growth does not need scientific support; after all, they both reflect fundamental aspects of the same economy. On the contrary, one is surprised that the correlation between DJIA and GDP turns out to be scientifically insignificant. Are our scientific criteria too stringent in this case?

If one accepts that there must be some correlation between GDP growth and stock-market growth as displayed in Fig. 5, then one cannot use the lack of scientific proof as an argument against the existence of correlation between the stock market and sunspots (Fig. 2), or between GDP and sunspots (Fig. 4). On the other hand, if these correlations are real, then we can venture long-range forecasts for the DJIA and the GDP.

The forecasts thus obtained carry a considerable uncertainty stemming not only from the limited correlation with the sunspots. The NASA-issued forecast for the future cycle of sunspots also carries uncertainty, and more importantly, there is a significant uncertainty due to the assumption that the present upward excursions of the DJIA and the GDP will turn out to be symmetric.

But long-range stock-market forecasts, as much as they are sought after, remain scarce and speculative. The levels forecasted here for the DJIA of 13908 in mid 2008 and 7919 in early 2014, may be daring but they have been obtained with minimal speculation. As for the GDP forecasts, obtained in exactly the same manner, it is unlikely that they will provoke any vehement objections from economists.

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Theodore Modis is the founder of Growth Dynamics, an organization specializing in strategic forecasting and management consulting. http://www.growth-dynamics.com.