Mikhail Gorbanev[1]

Shifting Pattern of Extraordinary Economic and Social Events in Relation to the Solar Cycle

Most notable claims linking events on Earth with solar cycle phases relate to solar maximums. Cyclical maximums of solar activity could be associated with economic recessions (W.S.Jevons) or revolutions (A.L.Chizhevsky). However, both the diminishing magnitude of solar cycles and the recent crisis events warrant closer attention to solar minimums. The ongoing global economic and financial crisis—caused by the "great lockdown" response to the new COVID-19 coronavirus pandemic—coincided with cyclical minimum of solar activity, as did the previous Global Financial Crisis of 2007-09. And before that, Asian crisis of 1997-98 began shortly after solar minimum. These events point to the new emerging pattern of global economic and financial crises coinciding with cyclical minimums of solar activity.

August 2020

Keywords: revolution, recession, business cycle, sunspot, solar cycle
JEL classification numbers: E32, F44, Q51, Q54

[1] Mikhail Gorbanev, PhD, is Senior Economist at the International Monetary Fund.
700 19th Street, N.W., Washington, D.C. 20431
(e-mail: Mikhail.Gorbanev@gmail.com)

Disclaimer: The views expressed in this paper are solely those of the author and do not represent IMF views or policy.

What are sunspots, solar cycles, solar maximums and minimums? Sunspots are temporary phenomena on the Sun's surface that appear visibly as dark spots compared to surrounding regions. They are caused by intense magnetic activity that inhibits convection and forms areas of reduced surface temperature. The quantity of sunspots visible on the Sun fluctuates with an approximate 11-year cycle known as the "solar cycle." Solar minimum refers to a cyclical period of low solar activity when the number of sunspots is lowest; solar maximum occurs in the years of most intensive solar activity when sunspots are most numerous. The cycles are numbered since mid-XVIII century, with the first numbered cycle running from the minimum in 1755 to the next minimum in 1766. Currently, the 24th cycle is unfolding from a minimum in December 2008 through the cyclical maximum in April 2014 toward the next minimum expected in the current year 2020.

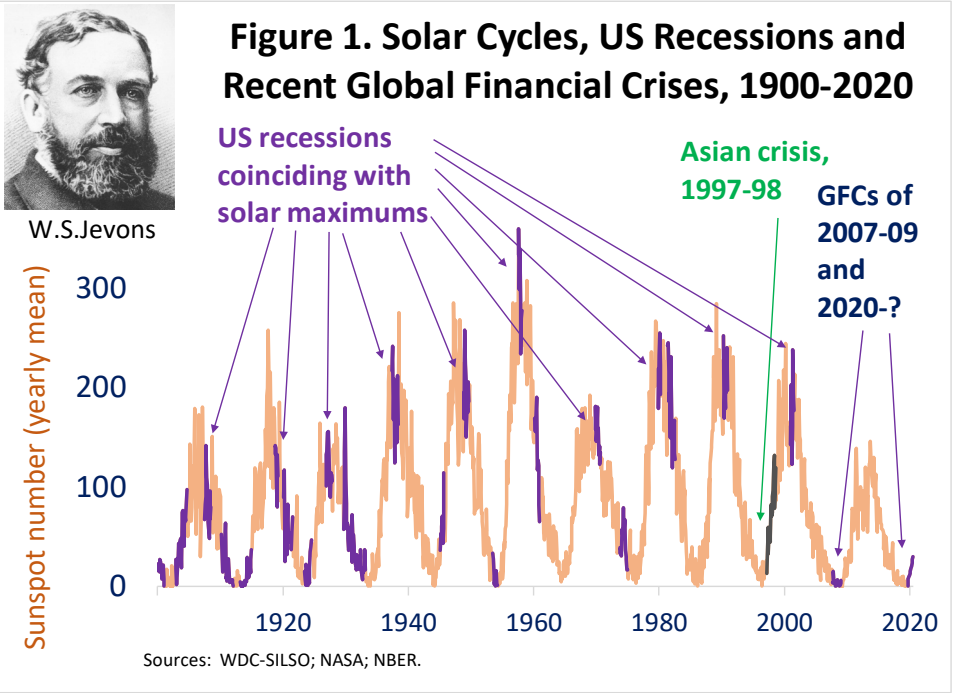
In addition to the sunspot number, which remains the primary measure of solar activity, many other indicators have been established and recorded, particularly in recent years. They include the indicators of radio activity, radiance, proton emission, solar wind, flares, and coronal mass ejections (CME). All these indicators broadly follow the solar cycle as measured by the sunspot index and reach their maximums around sunspot maximums (Kane 2002).

Possible impact on the economy and society. Famous British economist and statistician William Stanley Jevons developed the theory explaining the period of the trade cycle with variations in solar activity. In Jevons' lifetime, "commercial crises" occurred at intervals of 10-11 years (1825, 1836-39, 1847, 1857, 1866), which broadly matched the average solar cycle length. In his papers, Jevons carried back this history of "commercial crises" at 10-11-year intervals almost to the beginning of the XVIII century. This "beautiful coincidence," as he called it, produced in him a strong conviction of causal nexus, going from cyclical solar activity through crop-harvest fluctuations to commercial trade cycles (Jevons 1875, 1878, 1879, 1882).

Russian scientist Alexander Chizhevsky advanced a theory suggesting that the solar activity cycles shaped all human history. His thinking was influenced by the striking observation that two Russian revolutions of the early XX century (in 1905-07 and 1917) and several major European revolutions of the XIX century (in 1830, 1848, and 1871) occurred in the years of maximum solar activity. Chizhevsky scrutinized the available sunspot records and solar observations comparing them to riots, revolutions, battles and wars in Russia and 71 other countries for the

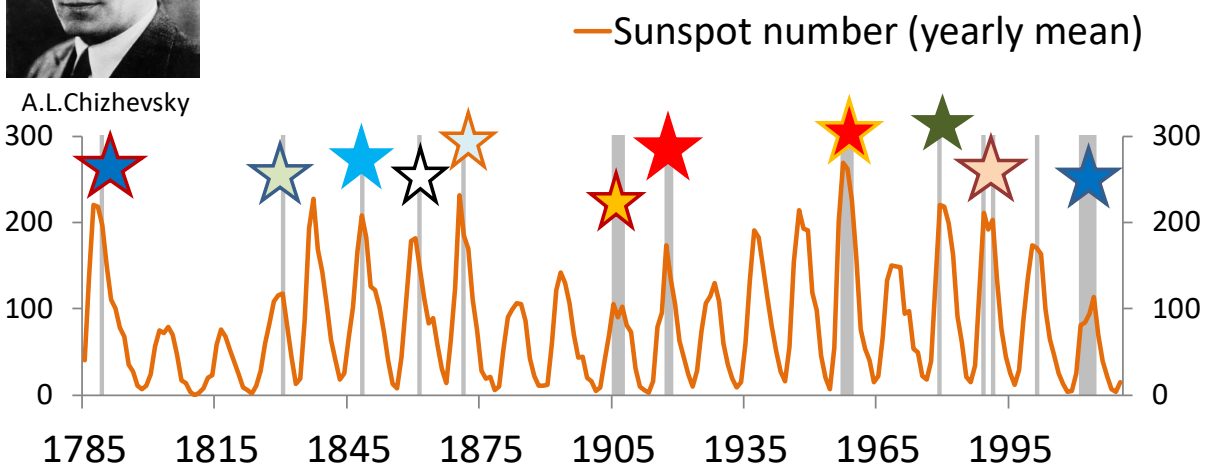
period from 500 B.C. to 1922. He found that a significant percent of revolutions and what he classified as "the most important historical events" involving "large numbers of people" occurred in the 3-year periods around sunspot maximums. Chizhevsky proposed to divide the eleven-year solar cycle into four phases: (1) a 3-year period of minimum activity (around the solar minimum) characterized by passivity and "autocratic rule"; (2) a 2-year period during which people "begin to organize" under new leaders and "one theme"; (3) a 3-year period (around the solar maximum) of "maximum excitability," revolutions and wars; (4) a 3-year period of gradual decrease in "excitability," until people are "apathetic." Through his subsequent studies, Chizhevsky came to believe that correlations with the solar cycles could be found for a very diverse set of natural phenomena and human activities. In his book, he compiled a list of as many as 27 of them, ranging from crop harvests to epidemic diseases and mortality rates (Chizhevsky 1924, 1938, 1976).

Empirical evidence. Even though the exact reasons of it remain unclear, economic recessions in the US and other advanced economies do occur more often around cyclical maximums of solar activity (Gorbanev 2012, 2015). In the US, where the longest series of consistent recession dates is available, during the entire XX century and in the early XXI century each cyclical maximum of solar activity overlapped closely with a recession (Figure 1). This striking pattern worked for over 100 years until the US economy did not go into recession after the maximum of solar cycle 24 in April 2014. Besides, modern research links solar cycles with various other economic developments (e.g., Belkin 2018).



A.L.Chizhevsky

Figure 2. Selected Revolutions that Overlapped with Solar Maximums, 1785-2020

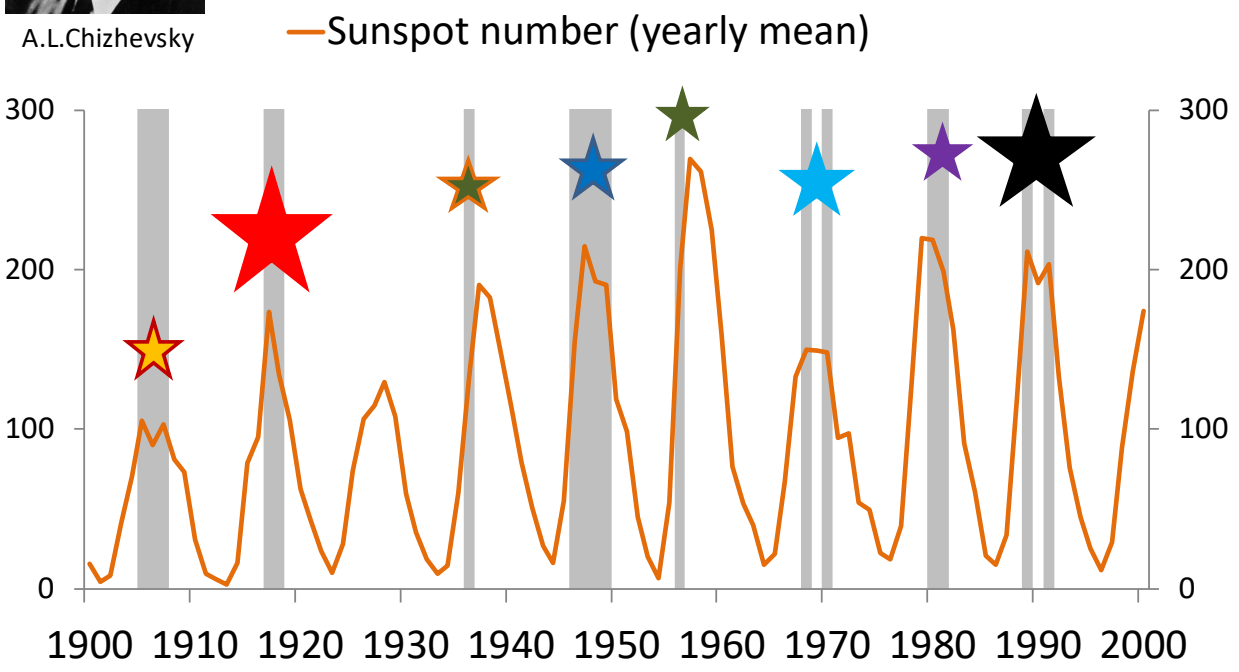


	Years	Events
★	1789	Great French Revolution
★	1830	Revolutions in Europe (France, Poland, Germany, Italy, Greece)
★	1848	Revolutions in Europe (Italy, France, Germany, Austria, etc.)
☆	1861	Secession of 13 southern US states that formed the C.S.A.
★	1871	Uprising in Paris "Paris Commune"
★	1905-07	Revolution of 1905-07 in the Russian Empire
★	1917 1918	February Revolution, Great October Socialist Revolution in Russia Revolution in Germany, collapse of the Austro-Hungarian Empire
★	1957-59	Revolution in Cuba
★	1979	Islamic Revolution in Iran
★	1989 1991	Fall of Berlin Wall, collapse of communism in Eastern Europe Collapse of Soviet Union and Yugoslavia
★	2010-14 2013-14	"Arab Spring": Revolutions in Egypt, Libya, Syria, Yemen, Tunisia, etc. Revolution in Ukraine

Sources: WDC-SILSO; NASA; history textbooks.

A.L.Chizhevsky

Figure 3. Advent and Demise of Communism in Europe in XX Century

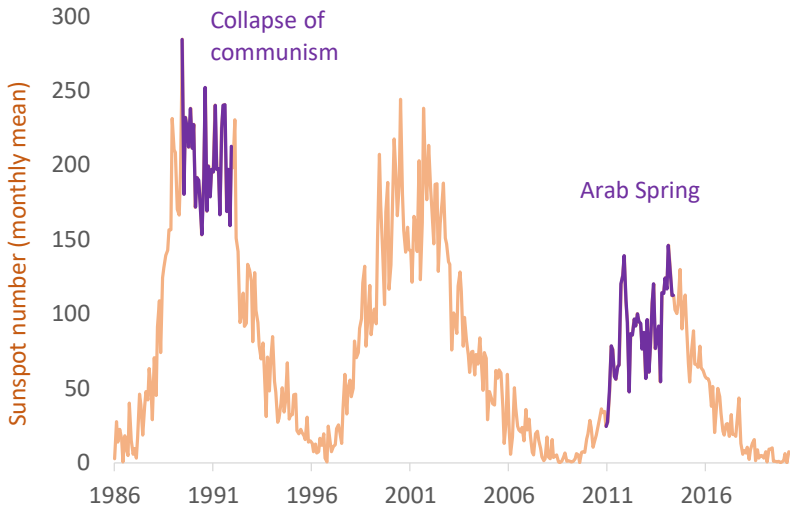


	Years	Events
★	1905-07	Revolution of 1905-07 in the Russian Empire
★	1917 1918	February Revolution, Great October Socialist Revolution in Russia Revolutions in Germany, Hungary, collapse of Austro-Hungarian Empire
★	1936	Revolution in Spain
★	1946-49	Conversion of Eastern Europe to socialism
★	1956	Hungarian revolution, Poznań protests in Poland
★	1968 1970	"Prague Spring" in Czechoslovakia Protests in Poland
★	1980-81	Polish crisis, "Solidarity" trade union, martial law
★	1989 1991	Fall of Berlin Wall, collapse of communism in Eastern Europe Collapse of Soviet Union and Yugoslavia

Sources: WDC-SILSO; history textbooks.

Moreover, major revolutions that change the course of history also occur more often at the time of maximums of solar activity (Figure 2). For example, solar cycle maximums provided milestones for the advent and demise of communism in Europe (Figure 3), from Paris Commune in 1871 (maximum of solar cycle 11) to the first and second Russian revolutions (maximums of solar cycles 14 and 15) to the ultimate collapse of the USSR and the Soviet bloc in 1989-91 (maximum of solar cycle 22). Most recent revolution wave named "Arab Spring" also overlapped with maximum of solar cycle 24 (Figure 4).

Figure 4. Two Most Recent Revolution Waves



Sources: WDC-SILSO; history textbooks.

Changing pattern. Solar cycle 24 was the weakest on record since the solar cycle 14 in 1902-13, and the next solar cycle 25 is projected to be of about the same magnitude.[2] As a result, the solar activity maximum in 2014 was also the weakest since the maximum of 1906, while the cyclical minimums of solar activity became more prolonged. During the minimum between cycles 23 and 24, Sun had 817 days without sunspots, which was a record since the solar minimum of 1914. And that historically low period of solar activity coincided with the Global Financial Crisis (GFC) of 2007-09, which was the deepest contraction of the world economy since the Great Depression of 1929-33. Further on, the ongoing cyclical minimum of the solar activity at the end of cycle 24 is shaping as one of the longest such episodes, with at least 700 spotless days already observed. And it coincided with yet another global economic and financial

[2] The NOAA/NASA co-chaired, international panel to forecast Solar Cycle 25 released their latest forecast for Solar Cycle 25 in December 2019. The forecast consensus: a peak in July 2025 (+/- 8 months), with a smoothed sunspot number (SSN) of 115. The panel agreed that Cycle 25 will be average in intensity and similar to Cycle 24.

crisis that is bound to eclipse the previous GFC of 2007-09 and, perhaps, even the Great Depression of 1929-33. Before that, the Asian crisis of 1997-98 began shortly after the solar minimum of 1996 (Figure 1). This chain of coincidences deserves a close attention.

Without pretending to offer an exhaustive explanation, let me point out that the crisis events observed during the most recent solar minimums are consistent with the theory developed by A.L.Chizhevsky. According to this theory, solar cycle minimums could be characterized by people's tranquility and even apathy. This risk-off mood appears consistent with financial crises. While the COVID-19 epidemic *triggered* the current crisis, it was "the great lockdown" policy response that turned the health crisis into the deepest economic and financial crisis in modern history. Out of all possible options of responding to the deadly pandemic, humankind collectively chose and implemented the most passive option of going into the global lockdown.

Literature references

Belkin, Vladimir, 2018: “Cycles of Oil (1970–2017), Metals (1980–2017) Price and the Eleven–Year Solar Cycle: Statistics of Strong Relations,” — Chelyabinsk Humanist, № 1 (42) / January 2018, pages 83-89. Available at SSRN.

Chizhevsky, Alexander, 1924: "Physical Factors of the Historical Process," — Kaluga, 1924. (In Russian: А.Чижевский. Физические факторы исторического процесса. — Калуга, 1-я Гостиполитография, 1924).

Chizhevsky, Alexander, 1938: “Les Epidemies et les perturbations electro-magnetiques du milieu exterieur,” — Paris, Hippocrate, 1938.

Chizhevsky, Alexander, 1976 : “The Terrestrial Echo of Solar Storms,” — Moscow, “Thought”, 1976 (In Russian: А.Л.Чижевский. Земное эхо солнечных бурь. — Москва, Издательство «Мысль», 1976.)

Gorbanev, Mikhail, 2012: “Sunspots, unemployment, and recessions, or Can the solar activity cycle shape the business cycle?” — MPRA Paper, No. 40271, July 2012.

Gorbanev, Mikhail, 2015: “Can solar activity influence the occurrence of economic recessions?” — MPRA Paper, No. 65502, July 2015.

Jevons, William Stanley, 1875: “Influence of the Sun-Spot Period on the Price of Corn,” — A paper read at the meeting of the British Association, Bristol, 1875.

Jevons, William Stanley, 1878: “Commercial crises and sun-spots,” — “Nature,” Volume xix, November 14, 1878, pp. 33-37.

Jevons, William Stanley, 1879: “Sun-Spots and Commercial Crises,” — “Nature,” Volume xix, April 24, 1879, pp. 588-590.

Jevons, William Stanley, 1882: “The Solar-Commercial Cycle,” — “Nature,” Volume xxvi, July 6, 1882, pp. 226-228.

Kane, R. P., 2002: “Evolutions of various solar indices around sunspot maximum and sunspot minimum years,”—Annales Geophysicae, 2002, 20: 741–755.

Methods. The results reported in the article are derived from comparing data series for sunspots with dates of US recessions and most important revolutions.

Data availability statement. The data that support the findings of this study are publicly available from WDC-SILSO, Royal Observatory of Belgium, Brussels; US National Aeronautics and Space Administration (NASA); US National Bureau of Economic Research (NBER); history textbooks and Wikipedia. Further information on the data that support the findings of this study are available from the author upon request.